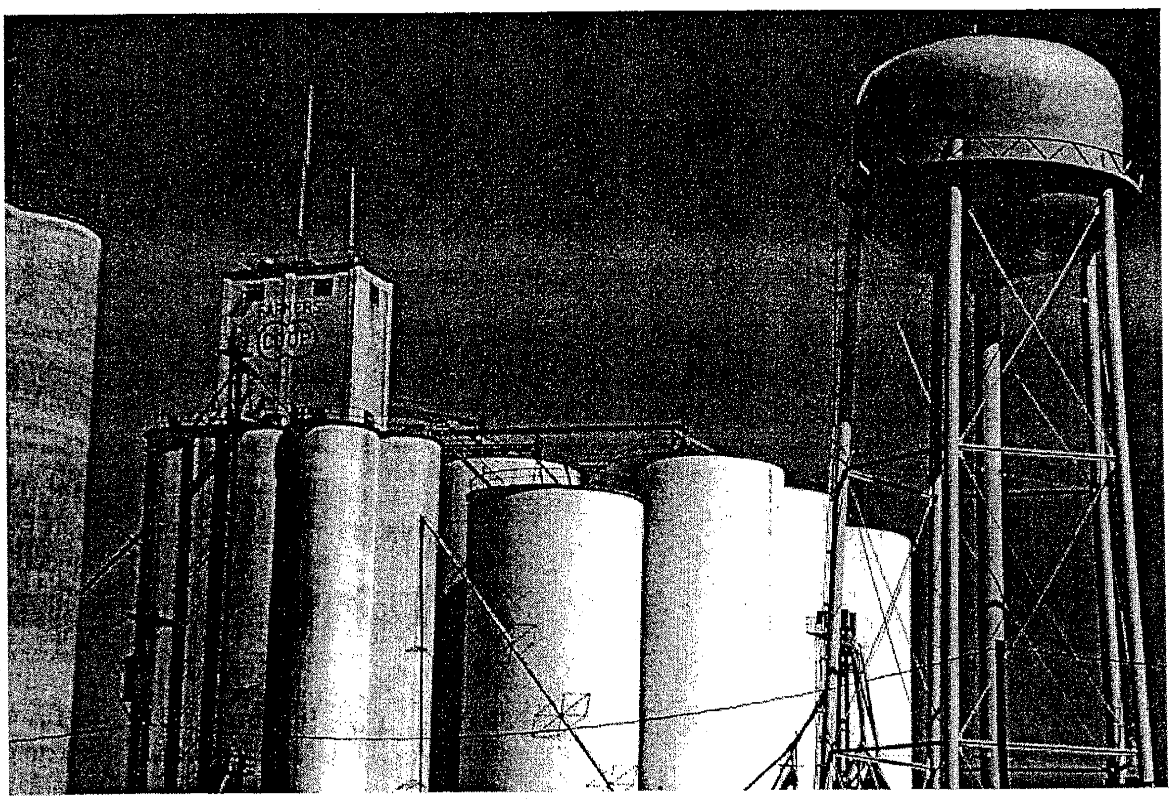
Appendix 1

Iowa Wellhead Protection Plan

IOWA
WELLHEAD PROTECTION PLAN



IOWA DEPARTMENT OF NATURAL RESOURCES
PAUL W. JOHNSON, DIRECTOR
SEPTEMBER 1999

IOWA DEPARTMENT OF NATURAL RESOURCES
WALLACE STATE OFFICE BUILDING
DES MOINES, IOWA 50319-0034

IOWA
WELLHEAD PROTECTION PLAN

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The Iowa Wellhead Protection Program is sponsored in part by the U.S. EPA, Region VII under the Public Water Supply Supervision Fund grants.

September 1999

Iowa Department of Natural Resources
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ACOE	Army Corps of Engineers
AWWA	American Water Works Association
BMP	Best management practice
CERCLA	Comprehensive Environmental Recovery and Compensation Liability Act
CWA	Clean Water Act
DWSRF	Drinking Water State Revolving Fund
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPD	Environmental Protection Division
FEMA	Federal Emergency Management Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
GSB	Geological Survey Bureau
IAC	Iowa Administrative Code
IDALS	Iowa Department of Agriculture and Land Stewardship
IDNR	Iowa Department of Natural Resources
IFB	Iowa Farm Bureau
IGWA	Iowa Groundwater Association
ISU	Iowa State University
LUST	Leaking underground storage tank
MCL	Maximum contaminant level
NRCS	Natural Resources Conservation Service
PL	Public Law
PWS	Public water supply
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
TOT	Time of travel
TSCA	Toxic Substances Control Act
UHL	University Hygienic Laboratory
UIC	Underground injection control
UNI	University of Northern Iowa
UST	Underground storage tank
WHAEM	Wellhead Analytic Element Model
WHPA	Wellhead Protection Area
WQB	Water Quality Bureau
USGS	United States Geological Survey

CONVERSIONS

LENGTH

1 inch (in) = 2.54 cm
1 foot (ft) = 30.48 cm = 0.3048 m
1 yard (yd) = 3 ft = .914 m
1 mile (mi) = 5,280 ft = 1,609 m = 1.609 km

1 centimeter (cm) = 0.01 meter = 0.394 inches = 0.033 feet
1 meter (m) = 39.37 inches = 3.28 feet = 1.09 yards
1 kilometer (km) = 0.62 miles

AREA

1 square foot (ft^2) = .093 m^2
1 square mile (mi^2) = 640 acres = 2.59 km^2
1 acre (ac) = .495 ha

1 square meter (m^2) = 10.76 ft^2
1 square kilometer (km^2) = 247 acres = 0.39 mi^2
1 hectare (ha) = 2.47 ac

VOLUME

1 gallon (gal) = 0.133 ft^3 = 0.00379 m^3
1 cubic foot (ft^3) = 7.48 U.S gallons = 0.028 m^3

1 liter (l) = 0.264 US gallons
1 cubic meter (m^3) = 264 U.S. gallons = 35.3 ft^3

FLOW RATE (DISCHARGE)

1 gallon per minute (gpm) = 0.134 ft^3/min = 192.5 ft^3/day = 70321 ft^3/year
1 cubic meter per sec (m^3/s) = 35.3 ft^3/s = 15,800 gpm

HYDRAULIC CONDUCTIVITY (K)

1 foot per day (f/d) = .3048 m/d = 7.48 gal/d/ft^2
1 gallon per day per square foot (gal/d/ft^2) = 0.138 ft/d = 0.041 m/d
1 meter per day (m/d) = 3.28 ft/d = 24.5 gal/d/ft^2

TRANSMISSIVITY (T)

1 square foot per day (ft^2/d) = 0.0931 m^2/d = 7.48 gal/d/ft
1 gallon per day per foot (gal/d/ft) = 0.134 ft^2/d = 0.0124 m^2/d
1 square meter per day (m^2/d) = 10.76 ft^2/d = 80.5 gal/d/ft

IOWA WELLHEAD PROTECTION PLAN

OVERVIEW

The Iowa Wellhead Protection Program is a **voluntary** program designed to help public water suppliers prevent contamination of their water supply through identification and management of a wellhead protection zone. This document provides public water suppliers with the necessary information and methodology to develop a local wellhead protection plan.

The wellhead protection plan as presented is applicable to all public water suppliers including community and non-community supplies.

Local water suppliers, working closely with the community, have the responsibility of developing and implementing a local plan. A variety of state, federal, and private organizations can supply technical assistance. For community water supplies, local community involvement is essential for the successful implementation of a wellhead plan.

Local water suppliers and the communities they serve have the option of submitting a plan for existing wells to the Iowa Department of Natural Resources for review. Although not required, this would enable suppliers to apply for monitoring waivers.

It is to be emphasized that the materials and forms contained in this document constitute only one possible approach to wellhead protection. Many other methods are available.

The following are the basic steps followed during development of a local wellhead protection plan:

- ◆ Assemble Local Wellhead Team
- ◆ Obtain Wellhead Area Delineation
- ◆ Conduct Contaminant Inventory
- ◆ Develop Implementation Strategies
- ◆ Develop Contingency Plan
- ◆ Conduct Public Hearings or Meetings on the Plan
- ◆ Implement Wellhead Plan/Update Plan

CHAPTER 1

WELLHEAD PROTECTION

Program Purpose and Goals

Iowa's groundwater is a precious and potentially vulnerable natural resource. An estimated 80% of Iowa's drinking water is provided by groundwater from private and public wells. The demand for good quality groundwater continues to increase for drinking water, and for agricultural, commercial, and industrial activities. Thus, protection of groundwater is essential to the health, welfare, and economic prosperity of all citizens of the state. The complexity of geologic settings across the state which control the distribution and vulnerability of groundwater supplies in Iowa, coupled with the potentially adverse impacts of land uses associated with an increasing urban population and widespread use of agricultural chemicals on water quality, give rise to a variety of potentially sensitive issues.

In 1987, the Iowa legislature passed the Iowa Groundwater Protection Act to help preserve the quality of Iowa's groundwater and to clean up existing contamination. That legislation includes programs to manage agricultural practices, solid-waste disposal, household hazardous wastes, gasoline storage tanks, fertilizers, pesticides, landfills, and watersheds. The goal of these programs is to prevent contamination of groundwater from both point and non-point sources to the maximum extent practical, and, if necessary, to restore the groundwater to a potable state, regardless of current condition or use characteristics.

The Iowa Wellhead Protection Plan is intended to further the goals of the Iowa Groundwater Protection Act by providing a comprehensive program to protect the water resources used by public water supplies in the state and to protect the public from health dangers related to the consumption of contaminated groundwater. This is to be accomplished using a pro-active approach to management of a wellhead protection area. The Iowa Wellhead Protection Plan has been developed to provide public water suppliers with the necessary information and methodology to identify the surface and subsurface areas that contribute water to their wells. Once these wellhead protection areas are delineated, the water supplier and community can identify potential sources of contamination and select from a variety of management and/or educational approaches to improve the handling of potential contaminants within the delineated area. The benefits of wellhead protection include public health protection, groundwater protection, and protection of the water supplier's investment in its public water-supply system. Preventing groundwater contamination is much less costly than cleaning it up once contamination has taken place. Wellhead protection is to be accomplished through a wide range of public and private-sector actions. Once wellhead areas have been delineated and contamination sources have been identified, emphasis can be placed on regulations, incentives, public information and education, land-use controls, and other programs for controlling or reducing potential contamination sources.

Iowa's Wellhead Protection Plan is a voluntary program which can be implemented by the local water supplier with state assistance. All public water suppliers are encouraged to prepare a wellhead protection plan to protect existing wells from potential sources of contamination. Public water supplies may be managed through cities, counties, or townships, or may be managed by businesses, cooperatives, nonprofit organizations, or individually-owned water supplies which serve the public. Many Iowa communities are in the process of developing or have developed wellhead protection plans.

Program Requirements

The Federal Safe Drinking Water Act was enacted in 1974 to provide safe public drinking water and to protect public sources of drinking water from contamination. The U.S. Environmental Protection Agency is responsible for administration of the SDWA. The 1986 SDWA Amendments strengthened provisions for protecting groundwater by requiring each state to develop and implement a wellhead protection plan. Section 1428 of the Amendments is intended to protect the wellhead areas of public water supplies from contaminants that may have adverse affects on the health of the water users. Specifically, the SDWA requires that every state wellhead protection plan address the following areas of concern:

1. The roles and duties of state and local governments and public water suppliers with respect to the development and implementation of a wellhead protection plan for a public water supply.
2. Acceptable criteria and methodologies for delineation of Wellhead Protection Areas (WHPA) for each wellhead based on reasonably available hydrogeologic data and other information.
3. Identification and risk assessment of contaminant sources within each WHPA, including all potential sources that may have an adverse health impact.
4. Management approaches that may include technical assistance, financial assistance, implementation of control measures, education, training, and demonstration projects.
5. Development of contingency plans for public water supplies (PWS) indicating the location of alternate drinking water supplies in the event of well or well-field contamination.

6. Recommendations for proper siting of new wells to minimize potential contamination.

7. Development of processes to ensure public participation.

The Iowa Department of Natural Resources (IDNR) is responsible for developing and implementing Iowa's Wellhead Protection Plan. This document will address the above elements in detail in later chapters.

The wellhead protection plan presented here was developed by the Geological Survey Bureau of IDNR with valuable input from a variety of sources. The Water Quality Bureau (WQB) of the IDNR provided funding for development of the plan and provided advice on all regulatory matters. An advisory committee was assembled which represented a broad spectrum of public interest groups, public health groups, business groups, federal, state, and local government agencies, and public water suppliers of various types and sizes. This committee dealt with the technical issues (resource allocation, feasibility, and effectiveness of a state's wellhead protection approach) and policy issues (the desirability and appropriateness of a state's wellhead plan). The members of the Wellhead Protection Committee (Appendix A) are to be commended for the time and effort they put into the development of the plan. This committee met numerous times during 1997 and 1998 to discuss technical details and policy considerations. Summaries of these meetings are in Appendix B. The Des Moines Water Works in cooperation with the Iowa Section of the American Water Works Association (AWWA) under a contract from and help of the Environmental Protection Division (EPD) of IDNR, developed a training video and support materials on wellhead protection. These materials were distributed at a series of statewide workshops for public water suppliers held in early 1997. Contact IDNR for a copy of these materials. Additional input was received during a series of public hearings held during March and April, 1998. Comments from these meetings are in Appendix C.

Wellhead Protection and Source Water Protection

The State of Iowa, Department of Natural Resources (IDNR) is also undertaking the development of a statewide source water protection program for public drinking water systems. This program fits the pollution prevention goals of IDNR, specifically to help public water supplies forestall pollution and protect their water resources at the local level, and thus enhance their drinking water operation and safeguard their water system. The program is designed to enable public water supplies to prevent source water contamination through long-term planning, minimizing hazard locations, and eliminating existing hazards. This plan is intended to fulfill the requirements of the Safe Drinking Water Act Amendments of 1996 (P.L. 104-182) for state source water delineation and assessment (Section 1453).

For all public water systems relying on groundwater, the delineation of source water protection areas will be in accordance with accepted methods under the Wellhead Protection Program of Section 1428 of SDWA. ("Guidelines for Delineation of Wellhead Protection Areas", EPA, June, 1987). Where a State has an approved wellhead protection program, a state may continue with the delineation approach established by that program (pages 2-13, EPA "Final State Source Water Assessment and Protection Programs Guidance"). Therefore, IDNR intends to continue approaches and concepts contained within this plan, as it develops and implements source water protection in Iowa. The wellhead protection program can be seen to be a subset of the overall source water protection program, which applies most of the same concepts to surface water and groundwater-surface water combined drinking water sources. Consequently, the relevant advisory panels for wellhead protection and for source water protection will comprise substantially the same membership.

The State source water delineation and assessment program plan was prepared by IDNR's Geological Survey Bureau with assistance from IDNR's EPD Water Supply Section. Concepts incorporated herein reflect appropriate material from EPA's <u>State Source Water Assessment and Protection Programs Draft Guidance</u> (April, 1997) and technical stakeholder meetings with EPA at Lenexa, Kansas on May 14-15, 1997; Kansas City, Kansas on March 10-12, 1998; Dallas, Texas on April 28-30, 1998; and EPA's <u>State Source Water Assessment and Protection Programs Guidance (Final Guidance), August, 1997.</u> IDNR's plan is intended to fulfill the requirements of Sections 1453 and 1454 of the Safe Drinking Water Act as amended in August, 1996.

CHAPTER 2

SPECIFICATION OF ROLES AND RESPONSIBILITIES FOR STATE AND LOCAL AGENCIES

Overview

- It is the responsibility of the local public water supplier to coordinate the development and implementation of a wellhead protection plan.

- The IDNR will stimulate interest in development of local wellhead protection plans through educational presentations and encouragement during sanitary survey reviews.

- The IDNR will provide technical assistance for development of local plans as resources allow.

- Regulatory units within the IDNR will take into consideration the concept of wellhead protection when promulgating new rules.

- The IDNR will consider the impact of new permits for regulated activities in a wellhead protection zone.

- Other state, federal, and private organizations may be able to provide technical assistance in the development of local wellhead protection plans.

Background

The IDNR has primary authority for regulation of public water supplies in Iowa and is designated as the lead agency for the wellhead protection program. The Water Quality Bureau of IDNR has the major responsibility for administration of the state wellhead protection plan. The Iowa Well-head Protection Program is targeted at public water supply systems which derive all or part of their water supply from groundwater.

All water supplies which serve more than 25 people for more than 60 days per year or have 15 or more service connections are defined as public water supplies and fall under the requirements of Iowa Administrative Code [567] Chapter 40. Any of these systems may submit plans for the protection of their wellheads. However, in order to protect our groundwater resources, all well owners are encouraged to develop wellhead protection plans.

Participation in Iowa's Wellhead Protection Plan is voluntary. For those public water systems which participate, the program will provide tools to increase protection for public water supplies, and will also complement and enhance existing groundwater protection programs. The wellhead protection program as designed can involve a variety of agencies at all levels of government, as well as private organizations. While the IDNR has primary responsibility for program administration, it is ultimately the responsibility of the local water supplier to develop and implement a wellhead protection plan. The following section discusses the roles and responsibilities for each potential participant in the wellhead protection program.

Responsibilities of the Local Water Supplier

The local water supplier and their community will have the responsibility of developing and implementing a wellhead protection plan. This will involve organizing a team of interested citizens and officials to develop activities ranging from refining the delineation zone, obtaining additional contaminant inventory information, and developing management approaches and contingency plans. Information, technical assistance, and educational documents to aid this effort can be obtained from the U.S. Environmental Protection Agency, IDNR, the Iowa Rural Water Association, and other non-governmental organizations. Additional information sources are in the References section of this document.

The accompanying flowchart (Figure 1) shows the recommended steps in development of a local wellhead protection plan. It is, however, up to the local supplier to choose a method that is suitable for local conditions. These steps are outlined in more detail in the following chapters.

Responsibilities of the Iowa Department of Natural Resources

IDNR will provide assistance for wellhead protection upon request as resources allow. Instructional materials and a community guide for conducting a contaminant source inventory will be available from IDNR upon request. The Environmental Protection Division will notify all public water suppliers of the wellhead protection program requirements and opportunities. The Water Quality Bureau will oversee the progress of local wellhead protection plans by tracking efforts of

ASSEMBLE LOCAL WELLHEAD TEAM

Seek input from a variety of interests in development of the local wellhead protection plan.
Gather and organize resource materials for plan development.

OBTAIN WELLHEAD AREA DELINEATION

Obtain technical assistance as needed.
Collect background information pertaining to existing wells and local geology.
Select criteria for determining the wellhead area.
Select desired delineation method.
Submit delineation for review if desired.

CONDUCT POLLUTANT SOURCE INVENTORY

Assemble inventory team.
Assemble existing information on potential contaminant sources.
Provide training for team members on conducting a source inventory.
Do a "windshield survey" of existing sources.
Assess risks from each potential site.
Prioritize sites for development of management plans.
Conduct in-depth survey at selected sites.

DEVELOP IMPLEMENTATION STRATEGIES

Develop management strategies for each potential contaminant source.
Incorporate existing rules and regulations for potential pollutant sources.
Develop an implementation timetable.
Educate water users about the wellhead plan.

DEVELOP CONTINGENCY PLAN

Develop a plan of action to respond to water supply emergencies.
Develop options for alternative water supplies.

PUBLIC INPUT

Conduct public hearings on plan.
Publicize existence of plan.

IMPLEMENT WELLHEAD PLAN

Carry out the actions described in the plan.
Provide for periodic updates to the plan.
Submit plan to IDNR for review if desired,

Figure 1. *Wellhead plan flow chart.*

the public water supplier through both the technical (hydrogeologic or engineering) review process and sanitary survey inspections. This periodic evaluation will provide encouragement to public water suppliers to implement and update their wellhead protection plan. Promotion of wellhead protection will be accomplished via educational displays and lectures at appropriate meetings as well as informational announcements to each public water supplier. A general mailing will be conducted to all public water supplies as to the availability of a final, U.S. Environmental Protection Agency-approved plan.

Regulatory units within the IDNR will take into consideration the concept of wellhead protection when promulgating new rules. In addition, IDNR will consider the impact of new permits for regulated activities in the wellhead protection zone. Each entity that has regulatory authority over potential contaminant sources will continue to update their data and make this information available to the public. Notification of regulated activities within a wellhead protection zone will be provided to the PWS. IDNR will seek to develop agreements that recognize wellhead protection areas with other units of state and federal governments which have permitting responsibilities and applicable databases. Table 1, located in Appendix D, lists regulatory programs within the IDNR that may impact wellhead protection.

IDNR will also review and approve local wellhead protection plans. Criteria for review are contained in Chapter 8. Public water supplies with approved plans may be eligible for reductions in monitoring requirements.

The overall Iowa program will be reviewed and updated on a ten-year cycle. Review will be done both internally by IDNR management staff and by a technical coordinating committee consisting of outside stakeholders and department staff. Since the program is voluntary, review of the success is problematic. Rough goals for the program are to reach at least two-thirds of the community water supplies (~550 communities) and to review 50 plans.

Multi-jurisdictional Issues

Wellhead protection areas that cross local boundaries of authority require cooperative efforts between the jurisdictions involved in order to develop and implement an effective wellhead program. A memo of understanding may be a tool for cooperation between public agencies at the municipal, county, state, and federal level. Several public water suppliers in Iowa have wellhead protection areas that may extend across state lines. As wellhead protection plans are implemented for these supplies, it will be necessary to notify the appropriate agency in the adjoining state. If requested, IDNR will initiate discussions between the PWS and the adjacent state's designated wellhead protection agency.

This will most likely result in an agreement between the local supplier and the local jurisdiction within the adjoining state. Similar arrangements can be done if wellhead protection zones span federal or Tribal lands.

Responsibilities of Other Organizations

There are a variety of state, federal, and private groups which have an interest in wellhead protection. Many of these groups may be able to offer the local water supplier technical assistance in the development of local wellhead protection plans. Many state and federal agencies have regulatory programs that may affect wellhead protection (Appendix D, Table 2). Table 3 in Appendix D is a contact list for state and other agency personnel related to the programs listed in Tables 1 and 2. In addition, many non-governmental organizations will have a part to play in wellhead protection, primarily in providing information and/or technical assistance for plan implementation. A list of some of these organizations is in Appendix D, Table 4.

Potential Funding

Some money for wellhead protection activities can be obtained through the newly established Drinking Water State Revolving loan Fund program (DWSRF). Up to 15% of the overall DWSRF funds may be used by the: 1) PWS (in the form of a loan only) for source water protection including acquisition of land or a conservation easements and implementation; 2) PWS to provide technical and financial assistance, and develop and implement capacity development (viability assessment); 3) State to delineate and assess source water protection areas (limited to the first 4 fiscal years of the DWSRF program); and/or 4) State to develop and implement wellhead protection on either a local or statewide basis. The amount available to a PWS would be from $1 to 2 million for any year, in competition with other DWSRF projects for funding.

The U.S. Geological Survey (USGS) can provide technical assistance under their cooperative grants program. This requires a 1:1 match. The USDA Rural Development provides grants and loans that can be used for infrastructure improvement for small water systems. The Iowa Department of Economic Development provides grants and loans to communities for infrastructure improvements.

Other funding sources for wellhead protection necessarily must be local in nature. Creative and ad-hoc funding sources can be arranged. The National Center for Small Communities has put out a guide for community involvement in developing a state use plan for the DWSRF funds. EPA has recently completed a catalog of funding sources for watershed protection projects.

CHAPTER 3

WELLHEAD PROTECTION AREA DELINEATION

Overview

- Delineation consists of identification of an area, both surface and subsurface, that supplies water to a well. The purpose of delineating a wellhead protection area (WHPA) is to define the geographic area most critical to the protection of a well or well field.

- It is the responsibility of the local water supplier to obtain an initial delineation of the water source of each well. IDNR will commit to provide initial delineations to each public water supply system as part of its responsibilities under the source water protection program. Further delineations can be done by the water supplier using methods supplied in this document or can be obtained from outside sources such as private or public consultants.

- Delineation criteria are used partly to assess whether a contaminant traveling through subsurface materials will reach the well or wellfield. The recommended criteria for delineation under the Iowa Wellhead Protection Plan is time-of-travel (TOT). The time-of-travel criterion is used to represent the time it takes for groundwater or a contaminant to flow from a point within a well's zone of contribution to a well. A minimum two-year TOT is recommended for protection from pathogens and a five-year TOT for protection from chemical contaminants.

- Methods for delineation vary in complexity, required hydrogeologic data, and cost of implementation. Recommended methods utilize a time-of-travel approach.

- A stepped approach to delineation of the wellhead protection area is recommended. All applicable laws for public water supplies, including a 200-foot radius of control, and all applicable separation distances remain in effect. The minimum requirement for delineation area under the plan is a 2500-foot fixed radius (except in karst settings). Management of the wellhead zone can begin within this area while a more accurate delineation is developed.

- In karst areas, an initial one-mile fixed radius will be applied while a more accurate delineation is developed.

- If state approval of the wellhead protection plan is desired, a more accurate delineation method than those recommended may be required.

Background

The federal SDWA defines a wellhead protection area as "the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well field." It requires that a wellhead protection area be defined using available hydrogeologic information on groundwater flow, recharge, and discharge. In simpler terms, delineation of the wellhead protection area is the process of determining what geographic area should be included in a wellhead protection plan to provide reasonable safeguards against contamination.

Establishing the wellhead protection boundaries for each well or wellfield is an essential element of a wellhead protection plan. It is the responsibility of the local water suppliers and their communities to delineate these boundaries, though IDNR will provide initial delineations to each public water supply system as part of its responsibilities under the Source Water Assessment and Protection program. Technical assistance on wellhead area delineation can be obtained from a variety of publications listed in the references section, from a groundwater professional, or from the IDNR-GSB.

When water is pumped from an aquifer, changes occur in the hydraulic conditions of the aquifer. Withdrawal of water by a well causes a drawdown of water levels in an area around the well. Spatially this is known as the zone of influence (ZOI) of a well. In cross-section this ZOI produces a cone shape known as the cone of depression (Figure 2). Flow velocities increase toward the well in response to increased hydraulic gradients.

The entire area recharging or contributing water to the well or wellfield over a specified time is defined as the zone of contribution (ZOC). For the purposes of wellhead protection, the ZOC is important because contaminants introduced within the ZOC could reach the well. Because the flow of groundwater is the primary process controlling movement of contaminants within the ZOC, contaminants can travel rapidly toward the well once they enter the ZOI where groundwater levels are significantly lowered by pumping.

The purpose of delineating a wellhead protection area is to define the geographic area most critical to the protection of a well or well field. Recharge to the aquifer supplying the well can occur in the area immediately adjacent to the well, or it can occur at a considerable distance away. Water may have traveled long distances along surface and subsurface routes to reach the well.

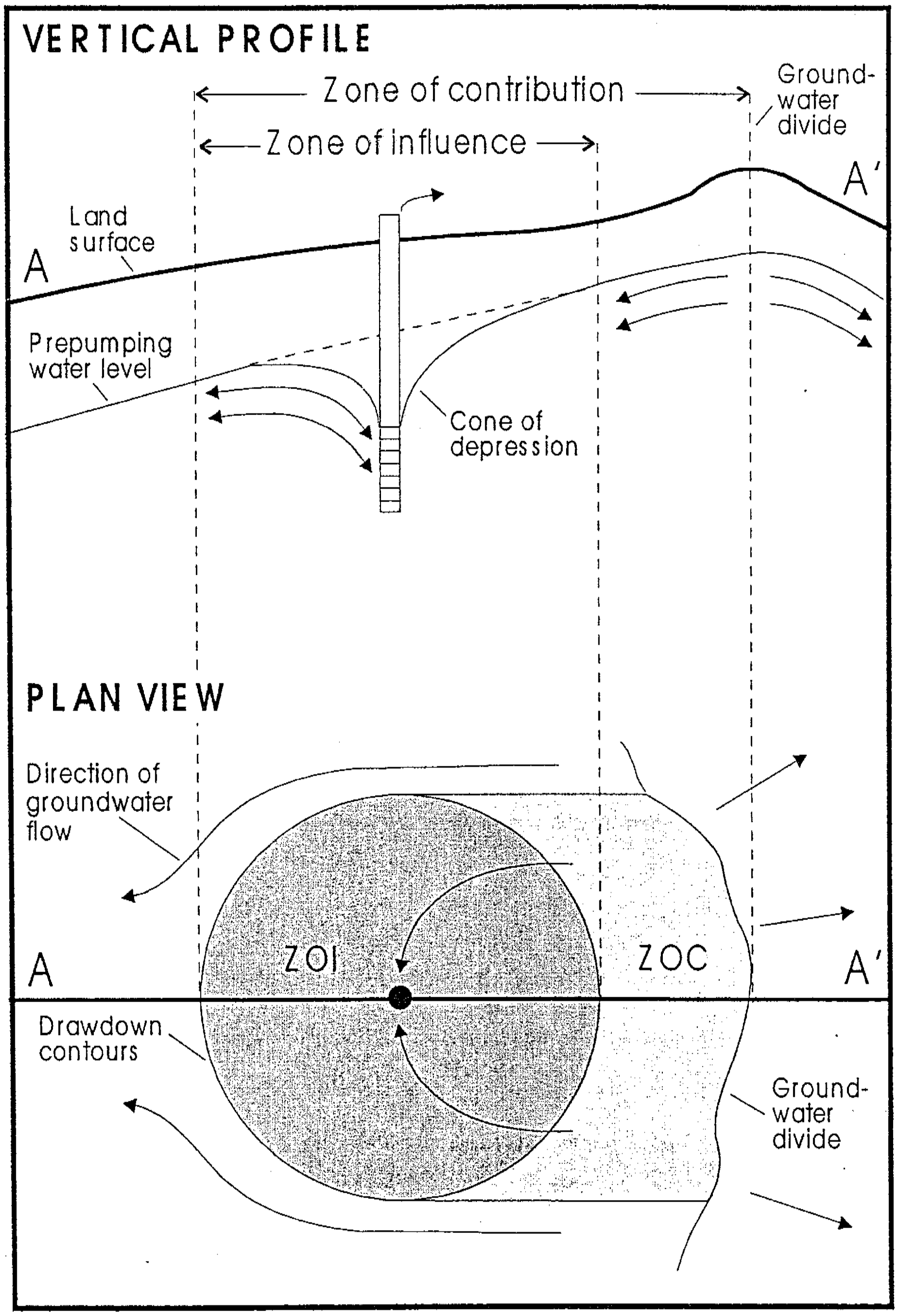


Figure 2. Profile and map views of the cone of depression, zone of influence, and zone of contribution for a typical wellhead protection area. (modified from U.S. EPA, Wellhead Protection: A Guide for Small Communities, 1993)

Iowa's Aquifers

In order to design an effective wellhead protection program, it is useful to have some information about the aquifer supplying water to the public water supply wells. A detailed well log for each separate well should be prepared that includes well location, details of well construction, geologic formations or lithology, pump setting, and capacity. Further information on preparing a log is contained in Chapter 8 on plan submittal. Specific details on well characteristics can be obtained from the well driller, the county sanitarian, the regional offices of the EPD, or the GSB. The following is an overview of the geology of Iowa's aquifers. Further information will be available in a publication on groundwater basics being developed by the IDNR-GSB.

Groundwater is acquired by drilling a well that provides access to an aquifer. The water in the aquifer can then be pumped to the land surface. An aquifer is a water-saturated geologic formation that is permeable enough to yield an appreciable water supply. In Iowa, groundwater supplies are withdrawn either from bedrock aquifers or from surficial unconsolidated aquifers. Characteristics of Iowa's aquifers are presented in Table 5.

There are three types of surficial aquifers: alluvial aquifers, buried channel aquifers, and glacial drift aquifers (Figure 3). Recharge of these aquifers occurs by infiltration of precipitation in the immediate area of the aquifer. Recharge can be relatively rapid, making these aquifers vulnerable to contamination. Because of these physical characteristics, wellhead protection is especially important in areas supplied by surficial aquifers. In general, alluvial aquifers are more susceptible to contamination because they occur at the land surface. Drift and buried channel aquifers can occur at depth and may have a significant thickness of low permeability material between the aquifer and the land surface. This will decrease the potential for contamination.

Five principal bedrock aquifers (Figure 4) are used in Iowa. From youngest to oldest these are: the Dakota, Mississippian, Silurian-Devonian, Cambrian-Ordovician (Jordan), and the Dresbach. They are comprised of sandstones and fractured carbonates (limestones and dolomites), and they are usually separated by confining beds that slow the movement of water between the aquifers. With the exception of the youngest bedrock aquifer, the Dakota, these aquifers lie in somewhat of a layer-cake fashion and slope to the southwest at approximately 13 feet per mile (Figure 4). Because of the slope and varying degrees of erosion over time, each layer in turn becomes the uppermost bedrock unit, and it is in these areas that recharge to the aquifer occurs. Thus a given aquifer occurs at different depths across the state. This has important implications for wellhead protection. In general, the deeper an aquifer the more likely it is to have a significant layer or

Table 5. Aquifer characteristics.

STRATIGRAPHIC UNITS		HYDROGEOLOGIC UNITS	MAJOR USE AREA	PREDOMINANT GEOLOGIC MATERIALS
Quaternary	Undifferentiated	Alluvial aquifers	Local aquifers, statewide	sand & gravel
		Drift aquifers	Local aquifers, statewide	sand & gravel, loess
		Quaternary confining unit		glacial till
		Buried channel aquifers	Local aquifers, statewide	sand & gravel
Tertiary	Undifferentiated	Tertiary Aquifer	Local to regional aquifers, W	sand & gravel
Cretaceous	Carlile Shale Greenhorn Ls. Graneros Shale	Cretaceous confining unit		shale, limestone
	Dakota Sandstone	Dakota Aquifer	Regional aquifer, NW, W	sandstone
Jurassic	Fort Dodge Fm.	Fort Dodge confining unit		gypsum
Pennsylvanian	Virgil Supergroup Missouri Supergroup Marmaton Group Cherokee Group Caseyville Fm.	Pennslyvanian confining unit	Local aquifers, SW, SC	shale, siltstone, sandstone, limestone, coal
Mississippian	Pella Fm.	Pella confining unit		shale, limestone
	St. Louis Ls. Spergen Fm.	Upper Mississippian Aquifer	Regional aquifer, SE, NC	
	Warsaw Fm.	Warsaw confining unit		shale
	Keokuk Limestone Burlington Ls. Gilmore City Ls. Maynes Creek Fm. North Hill Group	Lower Mississippian Aquifer	Regional aquifer, SE, NC	limestone
Devonian	Maple Mill Shale Aplington Fm. Sheffield Fm. Lime Creek Fm.	Devonian confining units		shale, limestone
	Cedar Valley Group Wapsipinicon Group	Devonian Aquifer	Regional aquifer, E, NC	limestone
		L. Wapsipinicon confining unit		limestone, shale
Silurian	Gower, Scotch Grove, Hopkinton, Blanding, Tete des Morts, Mosalem fms.	Silurian Aquifer	Regional aquifer, E	dolomite
Ordovician	Maquoketa Fm.	Maquoketa confining unit		shale, dolomite
	Galena Group	Galena Aquifer	Local aquifer, NE	dolomite, limestone
	Decorah, Platteville, Glenwood fms.	Middle Ordovician confining units		shale, limestone
	St. Peter Sandstone Prairie du Chien Group Jordan Sandstone	Cambrian-Ordovician Aquifer	Regional aquifer, statewide	dolomite, sandstone
Cambrian	Lone Rock Wonewoc Fm.	Cambrian confining unit		shale, siltstone, sandstone
	Eau Claire Fm. Mt. Simon Sandstone.	Dresbach Aquifer	Regional aquifer, NE, NC	sandstone, dolomite
Precambrian	Undifferentiated	Precambrian confining unit	Local aquifers	sandstone, metamorphic and igneous rocks

a)

b)

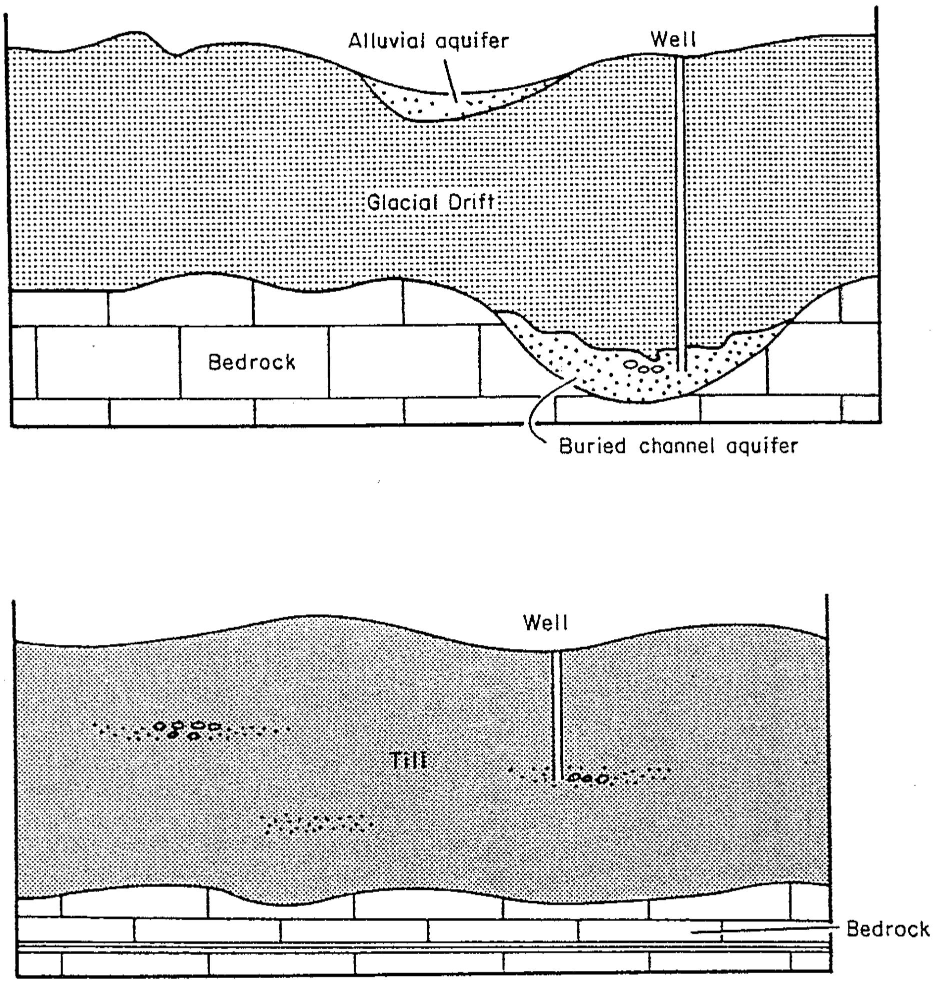
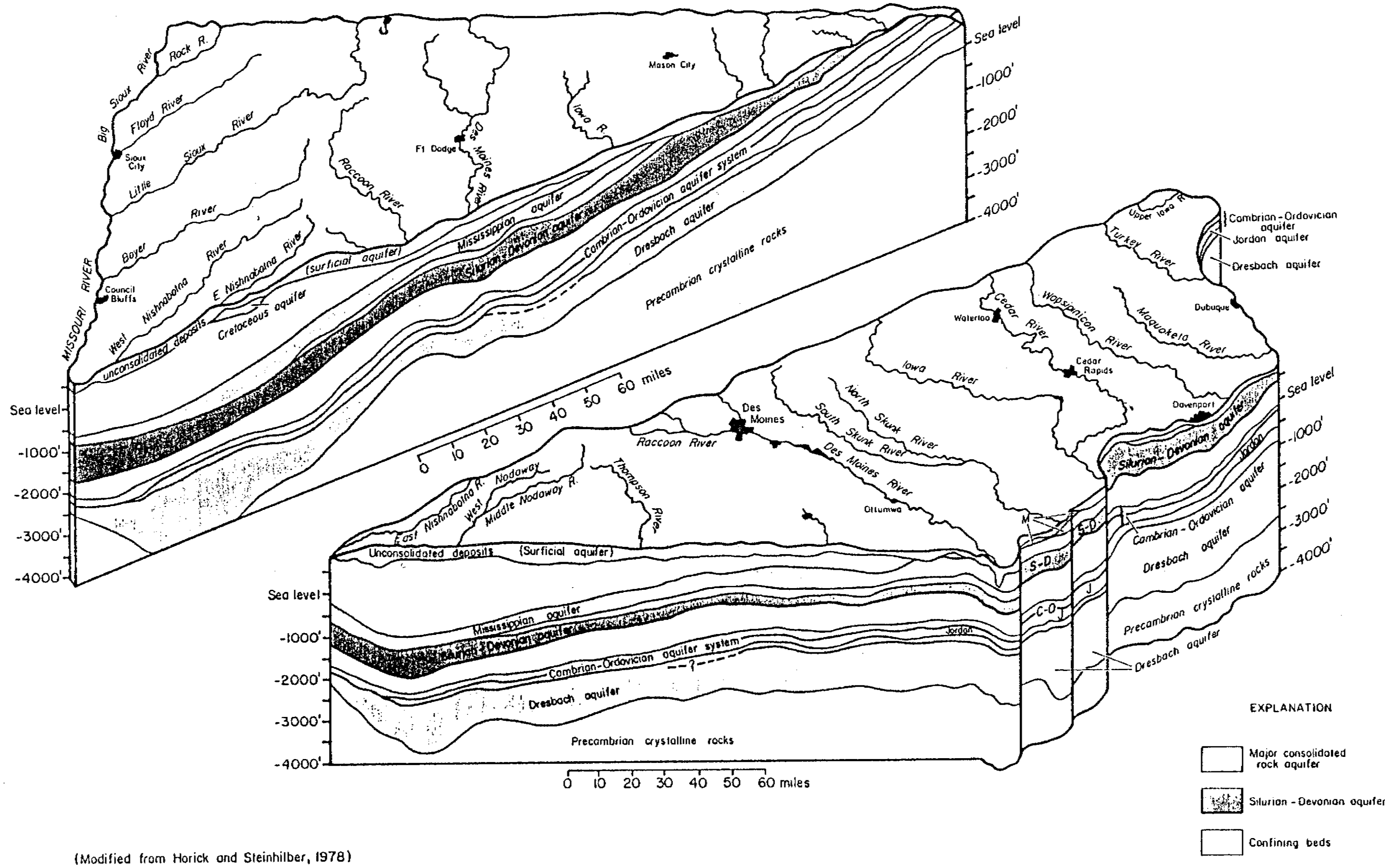


Figure 3. Schematics of a) alluvial and buried channel aquifers and b) glacial drift aquifers.

layers of low-permeability material separating it from the land surface.

The youngest bedrock aquifer, the Dakota, occurs in western Iowa and is relatively flat-lying. Over much of its extent, this sandstone aquifer is overlain by a significant thickness of low-permeability glacial materials, often in excess of 200 feet. The aquifer is discontinuous in the southwestern part of the state, although it is still overlain by thick glacial deposits. Slow recharge to the aquifer occurs through the glacial deposits.



(Modified from Horick and Steinhilber, 1978)

Figure 4. Bedrock aquifers of Iowa.

Aquifer Vulnerability

In any given area, the groundwater within an aquifer, or the groundwater produced by a well, has some vulnerability to contamination from society's activities. Groundwater vulnerability is a function of the geologic setting of an area, as this largely controls the amount of time that has passed since the water fell as precipitation, infiltrated through the soil, and began flowing to its present location, and the nature of the overlying landuse. This amount of time is called the "residence time" of the groundwater. Most sources of contamination are located on or near the land surface, and, from a geological perspective, are of quite recent origin. In Iowa, groundwater that is older than 200 years interacted with the land surface before factories, gas stations, landfills, or other potential sources of contamination existed. Groundwater that is older than 35 years interacted with the land surface before extensive use of commercial fertilizers and pesticides. In addition to controlling residence times of groundwater, the geologic setting of an area affects the rate at which contaminants will degrade or break down. Understanding how different geologic settings affect residence times and contaminant degradation are important in the development of an effective wellhead protection plan. The major factor controlling the vulnerability of aquifers is the degree to which they are confined. The potential for contamination is typically less in a confined aquifer than in an unconfined aquifer. Nevertheless, contamination of confined aquifers has occurred, and wellhead protection areas should be developed for all aquifer settings.

A confined aquifer is an aquifer overlain by low-permeability strata such as clay, till, or shale. The presence of the low-permeability material reduces the risk of a surface contaminant reaching a producing well. The thicker the confining layer, the more protection is afforded the aquifer. The potential for contamination of a confined aquifer is largely created from the presence of permeable pathways (e.g., faults, fractures, sinkholes, permeable sands, unplugged abandoned wells, or ungrouted deep wells) that can permit contaminant migration.

The wellhead protection concept is particularly important when dealing with unconfined aquifers, as these aquifers often have characteristics that make them susceptible to contamination from the surface. These aquifers are close to the land surface, and receive moderate to high amounts of recharge during most years. The localized nature of groundwater flow in these shallow, unconfined systems simplifies the delineation of a wellhead protection area based on hydrogeologic factors.

Wellhead protection can be more difficult to envision for wells that obtain water from a confined aquifer. In confined aquifers, some of the water that reaches a well may have traveled long distances over hundreds of years in a regional flow system, with recharge occurring many miles from the area of immediate use. A subsurface wellhead protection area can be delineated for a well in a deep confined aquifer. The area represents the flow path within the aquifer to the well. This area translated to the surface then becomes the wellhead protection area. In such cases, appropriate management plans need to concentrate on identification of potential pathways for contaminant migration and prevention of improper well construction and abandonment.

Groundwater / Surface Water Interactions

Groundwater and surface water may be connected. This is particularly true for alluvial settings where wells may indirectly obtain part of their water from surface water. Many of these wells are designated by IDNR as under the direct influence of surface water. These wells may require more complex management plans that extend to the surrounding watershed area.

Even if wells are located some distance from the river, they may be impacted by surface water. Small streams entering a valley from the uplands may lose water to the aquifer and could be a source of potential contaminants. Hydrogeologic mapping can be used to delineate the surface water boundaries for these watersheds.

Delineation Criteria

Delineation criteria are the conceptual factors on which delineation of the WHPA is based. They are the factors that determine whether a contaminant traveling through subsurface materials will reach the well or wellfield. The U.S EPA (1987) has recommended five criteria as the technical basis for delineating wellhead protection areas. These criteria are:

- Distance
- Drawdown
- Time of Travel
- Flow Boundaries
- Assimilative Capacity

Distance

The distance criterion is used to delineate wellhead protection areas by calculating a fixed radius measured from the well to the wellhead protection area boundary. This approach is the simplest, least expensive, and most direct approach to wellhead delineation. It is only recommended as a preliminary step however, because it does not include the processes of groundwater flow or contaminant transport.

Drawdown

Drawdown is the decline in water level elevation induced by a pumping well. The greatest drawdown occurs at the well and decreases with distance away from the well until an outer limit is reached where the water level is not affected by the pumpage. This outer limit is the zone of influence or the aerial extent of the well's cone of depression. Groundwater flow velocities increase toward a pumping well; therefore, drawdown can increase the flow of contaminants toward a well. The drawdown criterion may be used to delineate the boundaries of the zone of influence and this then may be used as a wellhead protection area.

Time of Travel (TOT)

The time of travel criterion is used to represent the time it takes for groundwater or a contaminant to flow from a point within a well's zone of contribution to a well. Using this criterion, isochrons (contours of equal time) of selected time periods are delineated on a map. The lateral area contained within a selected isochron is designated as the zone of contribution (ZOC) for the chosen time period and this is used as the wellhead protection area.

When using a TOT approach to wellhead protection, it is important to remember the assumptions and uncertainties involved which limit precision. In general, it is assumed that aquifers are very large, homogenous in texture, and do not display preferred directional orientation. Another assumption is that contaminants in the groundwater will move at the same velocity as the ground-water. This is not true for many contaminants, such as gasoline.

In reality, the movement of contaminants in groundwater is also affected by other processes such as dispersion and diffusion, which can increase the speed of contaminant migration, or absorption and biodegradation, which tend to slow or retard the movement of contaminants. The dispersion and retardation of contaminants in groundwater systems are poorly understood, and they are difficult to quantify even when studied in great detail. Therefore, the use of TOT distance calculations based on the average linear velocity of the groundwater remains the most feasible approach for a generalized statewide wellhead protection plan program that deals with many different aquifers and a large number of potential contaminants.

Flow Boundaries

The flow-boundary criterion uses determined locations of groundwater divides and/or other physical and hydrologic features that control groundwater flow to define the geographic area that contributes groundwater to a pumping well. This area is the zone of contribution (ZOC) of the well and is used as its wellhead protection area. This approach assumes that contaminants entering the ZOC will eventually reach a pumping well. Groundwater divides occur naturally or may be artificial, such as those created by a pumping well. The flow boundaries criterion is especially useful for small aquifers.

Assimilative Capacity

The assimilative capacity criterion takes into account the fact that the saturated and/or unsaturated section of an aquifer can attenuate the toxicity of contaminants before they reach a pumping well through the processes of dilution, dispersion, absorption, and chemical precipitation or biological degradation. This approach, however, requires knowledge of contaminant transport modeling and extensive information on the hydrology, geology, and geochemistry of the study area. Therefore, this approach is unrealistic for use in development of most wellhead protection plans.

Recommended Delineation Criteria

The Iowa Wellhead Protection Plan recommends that Time of Travel (TOT) criteria be used to determine the wellhead area. Using this approach, the distance groundwater will travel toward a well in a specified period of time can be determined. These TOT distances can be used to delineate intermediate areas for protection that are smaller than the total contribution area. *The choice of appropriate time periods for calculating TOT distances is to be decided by the local supplier*, but generally is based on one of the following considerations: the time required for contaminants to decay or attenuate in the aquifer, the time required to respond to contamination of a water supply aquifer (cleanup or installation of replacement supply), or the lifetime of the well. The TOT chosen will be used in the equations in the following sections on delineation methods. The variability of both the transport characteristics of the contaminants and the aquifer attenuation capacity means considerable judgment must be exercised in selecting the appropriate travel times upon which wellhead protection areas can be based using contaminant decay. Clean-up actions may take years to accomplish, and therefore require the delineation of a correspondingly large TOT distance. Based on the life of a well, a typical TOT to protect that well might be 25 to 40 years. In the cases where the average linear velocity of the groundwater is high this can result in a very large wellhead protection area. Often public water suppliers will calculate several distances based on TOTs of 2, 5, 10, or 25-40 years. Different management strategies are often applied within these respective zones.

The TOT criteria that are used will be determined by the local water supplier. The Iowa Wellhead Protection Plan recommends that at a minimum, a two-year TOT be used for protection from pathogens. A minimum five-year TOT is recommended for protection from chemical contaminants.

Delineation Methods

Five methods are commonly used for delineating wellhead protection areas. These methods vary in complexity, required hydrogeologic data, and cost of implementation. These methods are covered below in order of increasing cost and complexity. Figure 5 shows a comparison of a variety of methods for a single well.

Arbitrary Fixed Radius

This approach to wellhead protection involves drawing a circle of specified radius around each municipal well to delineate a wellhead protection area. The arbitrary fixed radius is an inexpensive, easily implemented method of wellhead delineation that requires little technical expertise. Many wells can be protected quickly using this approach.

The disadvantage of this method is that it is not based on hydrogeologic data. Therefore, this method might underestimate the area necessary for wellhead protection, or overestimate the area, thus resulting in overcompensation and increased costs of land management for wells that do not require a large wellhead protection area. A 1000-foot fixed radius is about 75 acres, while a 2500-foot fixed radius covers about 400 acres.

The arbitrary fixed radius is the initial step in wellhead protection area delineation. It is recommended that a fixed radius of 2500 feet be established around all public water supplies. This is to be considered a temporary measure until a more sophisticated delineation method can be applied.

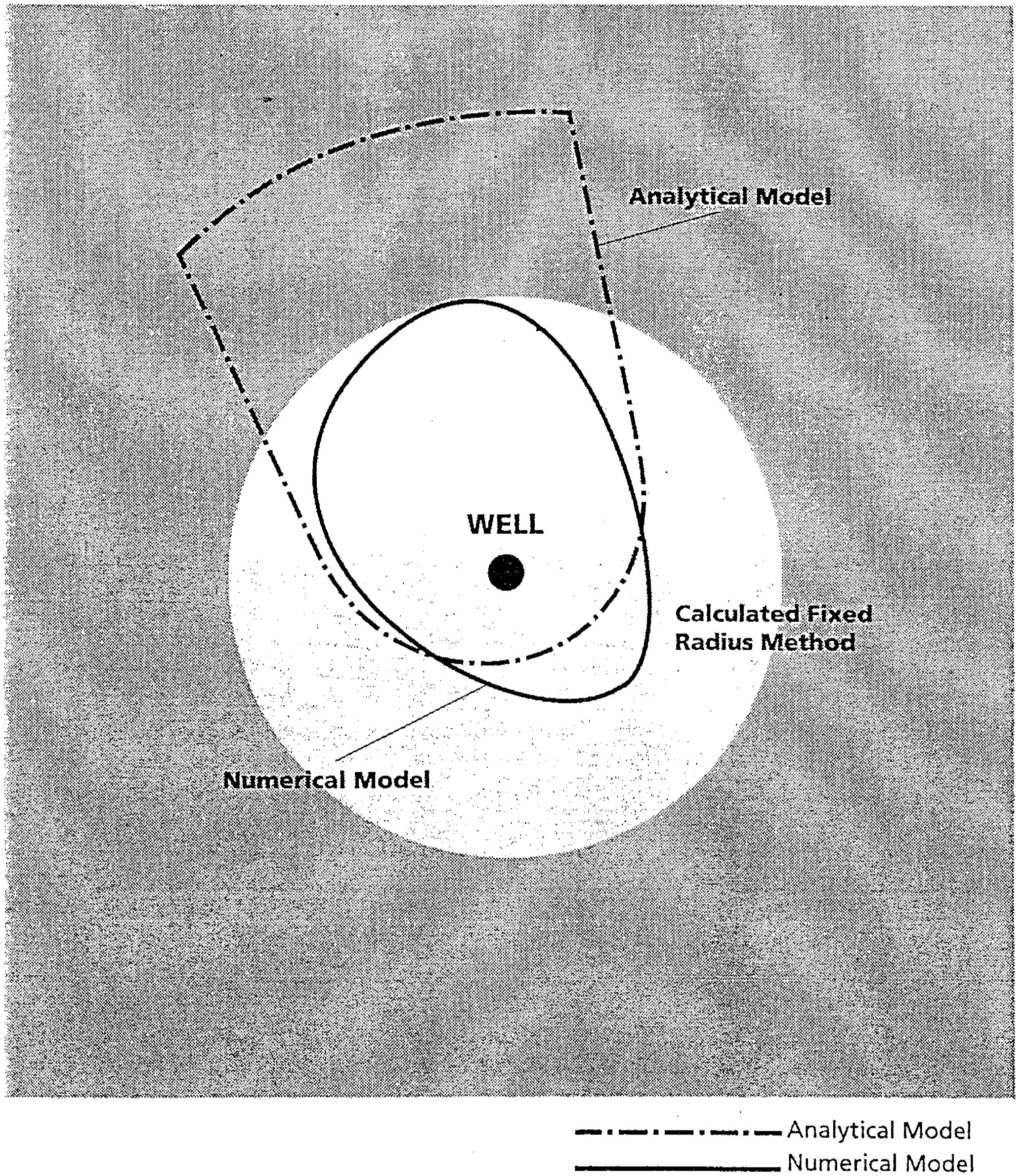


Figure 5. Wellhead delineation method comparison – ten-year TOT boundaries. (from Washington State Wellhead Protection Program Guidance Document)

Calculated Fixed Radius

The calculated fixed radius is a method that uses the hydrogeologic properties of the aquifer to determine a wellhead protection area that is specific to a given well. The goal of this method is to determine the rate at which groundwater moves through the aquifer. With this information, the distance that groundwater will travel toward a well in a specified time can be determined. These TOT distances can be used to delineate a series of wellhead areas that can be managed for different levels of protection. The TOT is chosen by the water supplier to represent the time that they have chosen as adequate to protect the water supply.

The calculated fixed-radius approach involves drawing a circular boundary around a well for a specified time of travel (Figure 6). It is based on the average linear velocity of the groundwater and the assumption that contaminants move at the same rate as the groundwater. The equation used is based on the volume of water that could be pumped from a well in a specified time period. The time period can be based on the estimated time necessary to clean up groundwater contamination before it reaches the well, the decay or attenuation rate of contaminants, or it can be more general, for example the life of the well.

This method is more accurate than the arbitrary fixed-radius method, is relatively easy to determine, and requires only a limited amount of technical expertise. A variety of methods can be used; the following two equations are presented as potential applications.

If no specific capacity or pump test data are available from which to estimate aquifer characteristics, a radius can be estimated from the pumping rate of the well and an estimated porosity of the aquifer. This approach assumes that water is being withdrawn from a cylinder of height, h, and radius, r (Figure 6). The equation is:

$r = ((Q^*t)/(\pi^*n^*h))^{1/2}$

Q= pumping rate of well (cubic feet per year)

t= time of travel to well (years)

h = screened interval of well (ft)

n = aquifer porosity (see Table 6)

$\pi = 3.14$

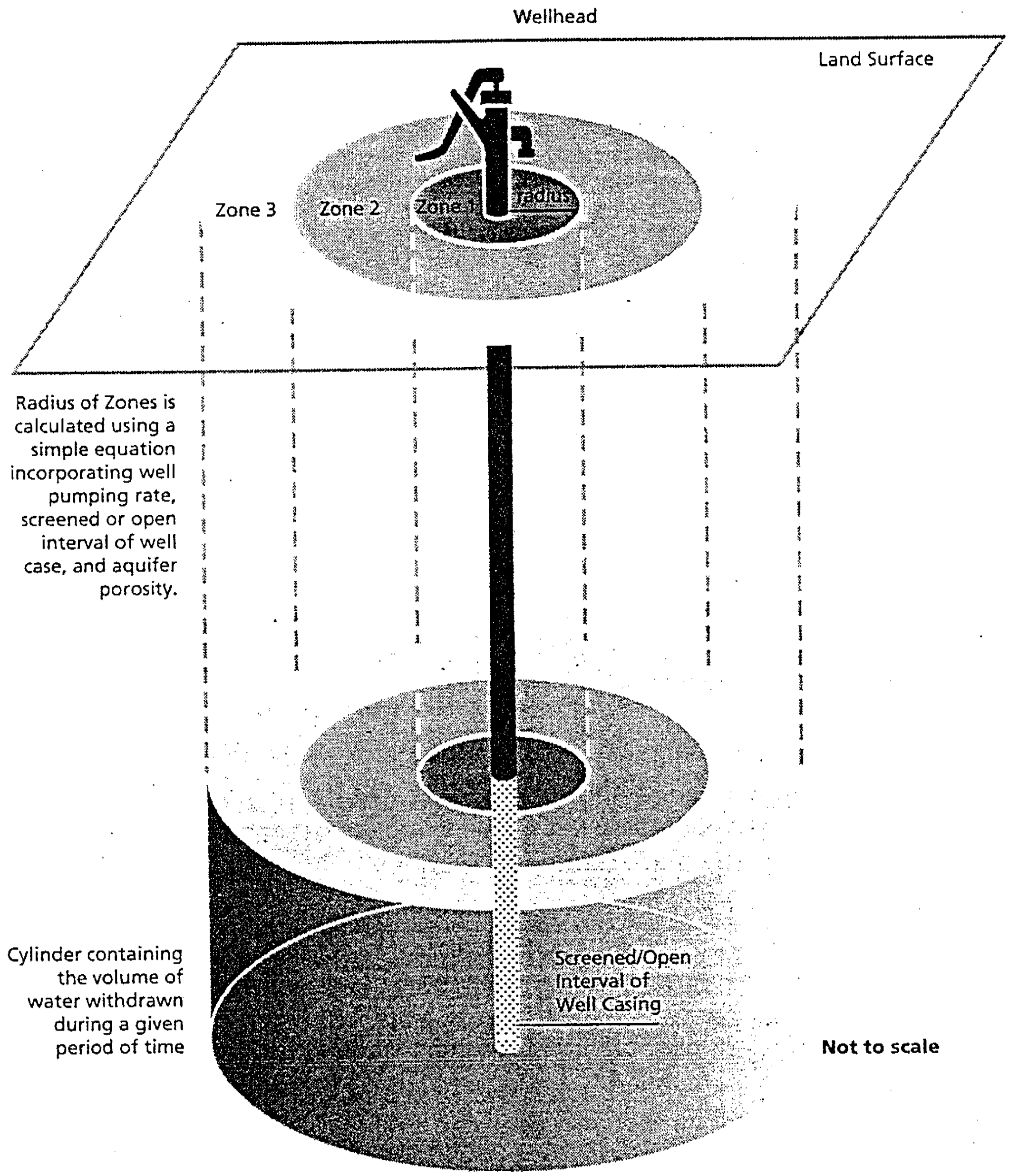


Figure 6. *Illustration of a calculated fixed-radius method. (from Washington State Wellhead Protection Program Guidance Document, 1995)*

Table 6. Porosities of common Iowa materials.

Sand and gravel	0.25
Sandstone	0.1
Fractured carbonate (limestone, dolomite)	0.05-0.01

If aquifer characteristics are known, then the data can be used to better define the radius based on Darcy's Law. The equation is:

$r = (T/b)*(h/l)*1/n*(t*365.25)$
T = aquifer transmissivity (ft^2/day)
b = aquifer thickness (ft)
h/l = water surface gradient during pumping (ft/ft)
n = aquifer porosity (Table 6)
t= time of travel (years)

Although the calculated fixed-radius method is relatively inexpensive, it may cost more than the arbitrary fixed-radius method because of the time needed to establish the hydrogeologic parameters required to solve the equation.

Analytical Methods

Analytical methods involve the use of mathematical equations to delineate wellhead protection areas. Computer programs such as the EPA's WHPA (Wellhead Protection Area Model) are readily available and are easy to use, running on either a DOS or Windows operating system. The result is often an oval, elongated along the direction of flow upgradient of the well (Figure 7). These models are helpful tools for understanding groundwater flow systems. Specific hydrogeologic data are required to satisfy these equations at each well. These data include transmissivity (T), porosity (n), hydraulic gradient (I), groundwater flow direction pumping rate (Q), and thickness (b) of the saturated zone.

This method is relatively inexpensive, although it may be necessary to hire a consultant, and costs will be higher if site-specific hydrogeologic data are not readily available.

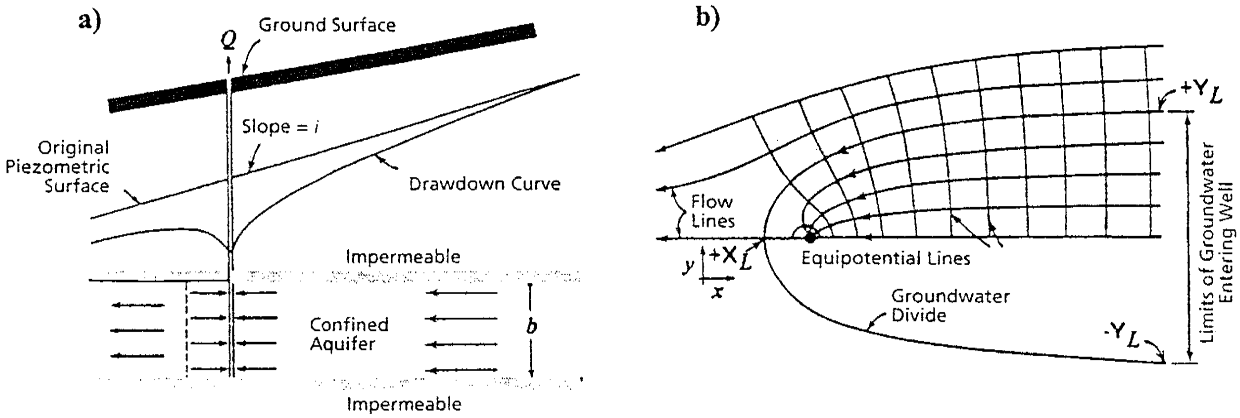


Figure 7. Illustration of an analytically derived model. (from U.S. EPA Guidelines for Delineation of Wellhead Protection Areas, 1993)

Hydrogeologic Mapping

Hydrogeologic mapping has a high degree of accuracy and produces an easily defensible wellhead protection area (Figure 8). This method maps physical flow boundaries using a combination of geologic, geomorphic, and geophysical methods. To determine the appropriate flow boundaries, studies of the aquifer are undertaken to identify varying rock characteristics, the extent and thickness of unconfined aquifers, groundwater drainage divides, and groundwater and surface water basin delineation.

This method can be used to delineate wellhead protection aquifers whose flow boundaries are close to the surface, such as glacial and alluvial aquifers, and those aquifers exhibiting different physical properties in different directions, such as fractured bedrock and karst. It can be used for confined aquifers where previous studies have been done to at least partially determine the groundwater basin. In areas where the groundwater basin has not been predetermined, this method will likely prove impractical. This method is often combined with other delineation methods to better define the wellhead protection area for surficial aquifers.

This delineation technique requires technical expertise in the geological sciences. Hydrogeologic mapping may prove expensive if sufficient hydrogeologic data does not exist and field investigations are necessary.

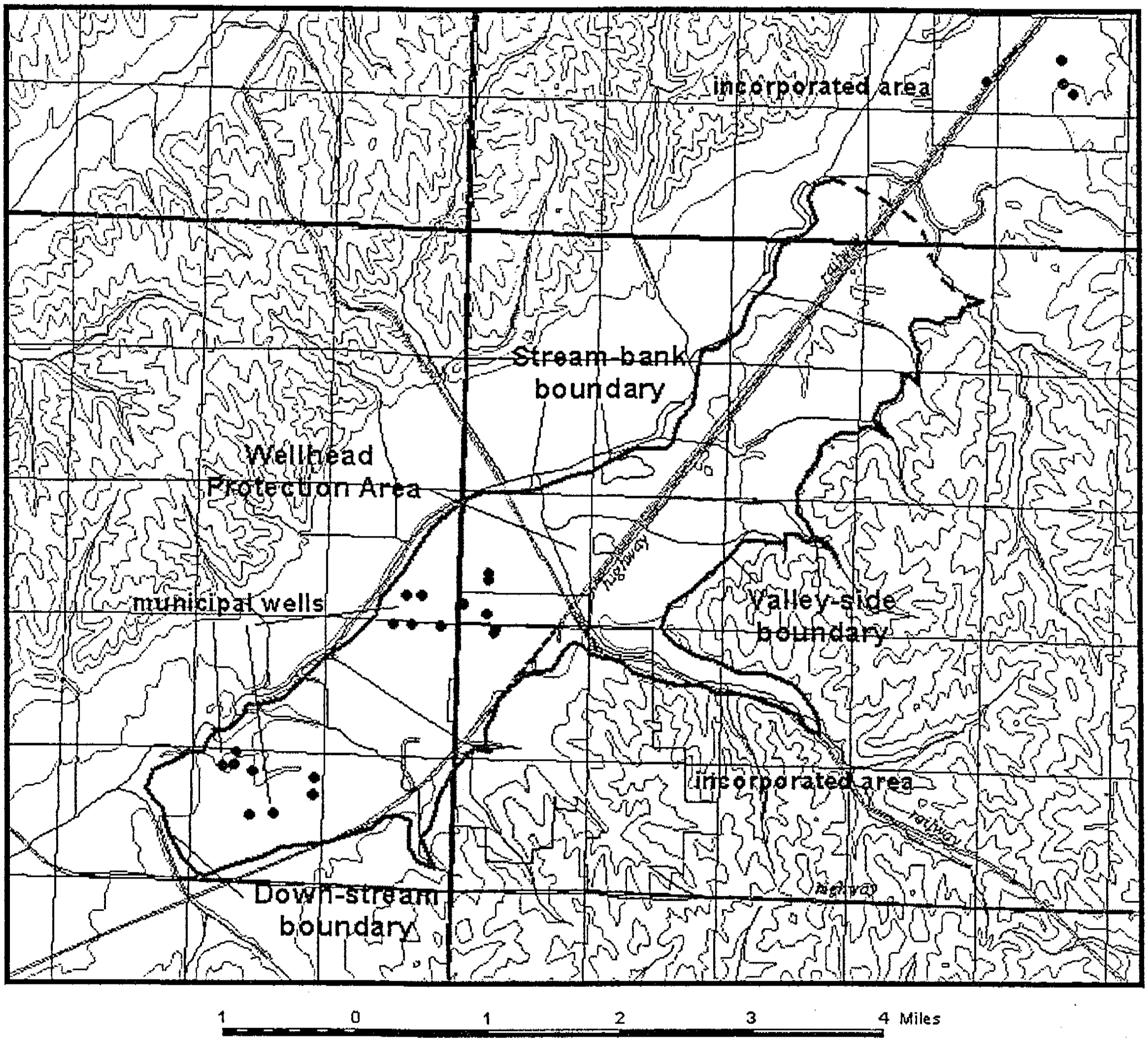


Figure 8. Illustration of a hydrogeologic mapping method.

Numerical Models

This method utilizes computer modeling techniques to simulate the three-dimensional boundaries of an aquifer using differential equations. The numerical method requires the formulation of a grid that simulates the aquifer. Hydrogeologic data for the aquifer are entered into the model, forming a matrix of equations that simulate the aquifer. As hydrologic conditions are varied, the model simulates the aquifers response to these changes.

The main advantage of computer models is their ability to model aquifers exhibiting complex hydrogeology. This requires a significant amount of field data covering a wide range of hydrogeologic parameters. The computer models are able to manipulate large volumes of analytical data. These models can also be predictive, allowing the user to determine the response to various management options. Properly formulated models also allow for a very high degree of accuracy.

The main disadvantage to numerical models is the potential cost. Because of required mathematical, computer, and hydrogeologic expertise, this method can be very expensive. However if a high degree of accuracy is needed, these models can be cost effective, especially if a large, detailed database is already available.

Recommended Methods

Public water suppliers can use a stepped approach to delineation of the WHPA for their wells and wellfields, especially in cases where an actual delineation would unduly delay the development of a wellhead plan. The first component of a wellhead protection plan is the 200-foot minimum radius of control that is required for all public water wells under IAC 43.3(7)b.1. In addition, all minimum distance requirements in IAC, Chapter 43 remain applicable under wellhead protection (Table 7). The next step is the implementation of a 2500-foot, fixed-radius circle around each well. This is the minimum requirement under the wellhead protection plan and will provide an immediate protection area that is very inexpensive to determine. Wellhead protection policies outlined in this manual should be implemented within the fixed radius circle to provide initial protection for the well or wellfield.

While the fixed-radius wellhead protection area is being administered, a more accurate delineation method should be used to refine the area. Municipal water suppliers may choose from any of the approved methods outlined above. As previously stated, Iowa recommends a TOT method be implemented using a minimum of a two-year TOT for protection from pathogens and a five-year TOT for protection from chemical contaminants. There are several scenarios under which a water supplier should give serious consideration to upgrading an initial delineation: 1) if the susceptibility analysis of the well indicates that it is highly susceptible to contaminants; 2) if the hydrogeologic setting suggests significant linearity (karst, highly fractured bedrock); or 3) if significant high-risk sources of contamination appear to be in the wellhead protection area.

If your well is in a karst setting (sinkholes, caverns, losing streams present in the area), and you suspect that your well may be drawing from a shallow rock unit, then a one-mile fixed radius is the minimum that can be used for delineation. However, a fixed-radius method is inadequate in a karst setting and a more accurate method of delineation should be used to provide adequate protection for the water supply. If you have questions about whether your water supply draws from a karst aquifer or the specific location of a State-identified sinkhole, call the IDNR-GSB.

If the more accurate method delineates an area smaller than the 2500-foot, fixed-radius circle, the plan should be reviewed by the IDNR prior to changing to the smaller wellhead protection area. Wellhead protection area boundaries should be periodically reviewed for possible changes. Changes can be made as more hydrogeologic data becomes available, or can be necessitated by an increase in pumping rates or the addition of new wells.

Table 7. Separation distances.

Type of operation	Iowa Admin. Code ref.	PWS	PWS Shallow	PWS Deep
Separation distances required under drinking water regulations		feet	feet	feet
Sanitary and industrial point discharges	567-41		400	400
Mechanical waste treatment plants	567-41		400	200
Lagoons	567-41		1000	400
Above ground chemical storage	567-41		200	100
Below ground (inc. tanks) chemical storage	567-41		400	200
Solid waste disposal site	567-41		1000	1000
Mechanical wastewater-treatment plants	567-43		400	200
Solid waste disposal sites	567-43	1000		
Cemeteries	567-43	200		
Lagoons	567-43		1000	400
Basements, pits, sumps	567-43	10		
Cesspools & earth pit privies	567-43		400	200
Soil absorption fields	567-43		400	200
Concrete vaults and septic tanks	567-43		200	100
Cisterns	567-43		100	50
Well house floor drain discharge to ground	567-43	5		
Water treatment plant wastes discharge to ground	567-43	50		
Sanitary & industrial discharges to ground	567-43	400		
Above ground chemical and mineral storage	567-43		200	100
On or under ground chemical and mineral storage	567-43		400	200
Animal pasturage	567-43	50		
Animal enclosure	567-43		200	100
Land application of solid animal wastes	567-43		200	100
Land application of liquid or slurry animal wastes	567-43		200	100
Animal waste storage tank	567-43		200	100
Animal waste solids stockpile	567-43		400	200
Animal waste storage basin or lagoon	567-43		1000	400
Earthen silage storage trench or pit	567-43		200	100
Private wells	567-43		400	200
Flowing streams or other surface water bodies	567-43	50		
Irrigation of wastewater	567-43		200	100
Water plant wastes to sewers: water main pipe	567-43	25		
Water plant wastes to sewers: sewer main pipe	567-43	75		
Water plant wastes to sewers: unknown pipe	567-43	200		
Sanitary & storm sewers, drains: water main pipe	567-43	25		
Sanitary & storm sewers, drains: sewer main pipe	567-43	75		
Sanitary & storm sewers, drains: unknown pipe	567-43	200		

Table 7. Continued.

Separation distances required under other permitted activities				
Sewer force mains: water main pipe	567-43	75		
Sewer force mains: water sewer pipe	567-43	400		
Chemical application to ground surface	567-43		200	100
Land application of solid waste	567-43		200	100
Public Wastewater Plants				
Wastewater treatment or lagoon	567-64		1000	400
Animal Feeding Operations				
Animal waste structures - aerobic, anaerobic	567-65		1000	400
lagoons, earthen manure basins, runoff control basin				
Animal waste structures - formed manure storage	567-65		200	100
structure, confinement building, open feedlot				
Land-Applied Sewage				
Land-applied sewage sludge	567-67	200		
Land-applied septage	567-68 & -69	500		
On-site wastewater				
On-site wastewater treatment - closed portion	567-69	200		
Sewer pipe encased in 6" of concrete	567-69	10		
Sewer pipe with approved joints	567-69	20		
Sewer pipe - watertight	567-69	75		
On-site wastewater treatment - open portion	569-69	200		
Solid Waste Management				
Farm waste, dead animals	567-101	200		
Sanitary landfills	567-103	1000		
Land application of solid waste	567-121	500		
Land application of petroleum contaminated soil	567-121	500		
Hazardous and Radioactive Waste				
Hazardous waste management facilities	567-151	5280		
Low-level radioactive waste facility	567-152	5280		
Pesticides				
Pesticide storage & mixing location (permanent)	21-44	400		
Atrazine use area	21-45	50		
Atrazine mixing, repacking area	21-45	100		

Shallow well means a well located and constructed in such a manner that there is not a continuous layer of low permeability soil or rock (or equivalent retarding mechanism acceptable to the IDNR) at least 5 feet thick, the top of which is located at least 25 feet below the normal ground surface and above the aquifer from which water is to be drawn.

CHAPTER 4

CONTAMINANT SOURCE INVENTORY

Overview

- A contaminant survey is necessary to ascertain what potential sources of contamination occur within the delineated wellhead protection zone.

- The first step is to assemble an inventory team. These people will help organize and participate in the survey, organize the data, analyze potential risk, and prioritize the sites for future management action. Community involvement in this phase is strongly recommended.

- A base map should be utilized which clearly shows the delineated wellhead protection area and all potential sources of contamination.

- All existing data should be collected prior to starting the survey. Lists of possible sources are included.

- A driving or walking survey of the area should be done by persons familiar with the area and with the types of facilities/land uses that may be potential contaminants. Additional help from a variety of service organizations could be recruited for this part of the assessment. Field survey forms are included in this chapter, although forms can be designed to suit the needs of the team.

- Once the initial inventory is done, the sites are ranked using information on the type of source, the distance from the well, and the potential vulnerability of the well and aquifer. Ranking is done first for each well and then for the water system as a whole. Again forms are included in the chapter for this purpose.

- A follow-up interview can be done if more detail is needed about particular facilities. This should be done by persons familiar with the goals and purposes of the wellhead protection plan and with the level of information needed to develop a successful plan.

- Procedures should be developed for periodic updates to the contaminant survey particularly as new wells are added or as land use in the wellhead area changes.

Introduction

Identification of potential sources of contamination within the wellhead protection area is an essential step in the wellhead protection process. Once contamination sources are known, management priorities can be set and follow-up procedures can be planned. IDNR will provide contaminant sources available from its databases to each public water supply system. Each public water supply is responsible for identifying additional potential contaminant sources within its own wellhead protection area.

Many human activities produce potential contaminants. Once groundwater is polluted, it is difficult to remove contaminants and costs of remedial actions are very high. The potential for contamination at a given site is influenced by the geology of the area, the type and quantities of potential contaminants present, and the handling procedures for the materials. This chapter includes a list of categories for potential sources of contamination and outlines procedures and approaches for identification and prioritization of these sources.

Federal Requirements

Subsection 1428(a)(3) of the federal Safe Drinking Water Act states that wellhead protection programs "shall at a minimum ... identify within each wellhead protection area all potential anthropogenic sources of contaminants which may have an adverse effect on the health of persons." The U.S. EPA defines an anthropogenic source as "any activity, performed by or caused by human actions, that is or can potentially be a source of contamination to ground water including human actions affecting natural contaminants." EPA defines a contaminant as any "organic, inorganic, radiological, or microbiological substance that is regulated under federal, state or local environmental programs, and any other substance that the state determines appropriate." Both point-source discharges and nonpoint pollution sources need to be identified. Point sources are those sites which have an identifiable discharge area from a well-defined source. These include industrial and commercial sources, tanks both above and below ground, chemical storage areas, sewage outfall areas, and other types. Nonpoint sources tend to have a discharge area that is more diffuse and may cover a large area. Applications of pesticides and fertilizers on lawns or agricultural fields are typical examples of nonpoint source activities.

The intent of the Safe Water Drinking Act is to encourage a comprehensive identification and inventory process for each wellhead protection area. As directed by the Safe Drinking Water Act, all potential sources of contamination having an adverse effect on public health must be identified within each wellhead protection area.

Procedures

Accomplishing the objectives of the contaminant source inventory will require the following steps:

- Assemble the source inventory team.
- Assemble existing sources of information including base maps, databases, and source lists.
- Conduct the field inventory.
- Assess relative risk and set priorities.
- Conduct the interview survey.

The contaminant source inventory itself is designed to be accomplished in two phases: an initial field survey in which land uses or activities which may be potential sources of contamination are identified; and an interview phase in which detailed data concerning the potential contaminants are obtained at each site identified during the field survey.

The steps listed above are only guidelines for doing a contaminant source inventory. Individual public water suppliers may choose to use some or all of these methods or may design their own program for gathering contaminant source data. However, it is important to realize that gathering contaminant source data is a vital step in implementing a successful wellhead protection program. Further information on contaminant source inventories will be found in "A Guide to Conducting Contaminant Source Inventories." This document will be available from the IDNR and other organizations and will provide a more detailed description and examples of the contaminant source inventory process.

Assemble Source Inventory Team

Protection of a public water supply benefits all who use it. **Local involvement** is **vital** to the success of the wellhead protection plan, so it follows that members of the community need to become involved in the wellhead protection process. Furthermore, involving the community from the beginning builds support for the wellhead protection plan. When key community members understand and support the plan, the likelihood that other citizens will support the plan and become actively involved in management of the wellhead protection area is increased. If the community is not involved, the likelihood of acceptance and successful implementation is reduced.

One of the most important ways to ensure local involvement is to form a team of community members to perform the contaminant source inventory. The number of individuals required to conduct the inventory will depend on the size and location of the wellhead protection area. If the wellhead protection area is small, or in an area with a low number of contaminant sources or few types of sources, the personnel requirements will be lower than if the wellhead protection area is located in a large industrial area. Although the size of the source inventory team will vary from one community to another, it is important that the various interests in each community are represented. Diversity of perspectives among team members is important. Groups likely to participate in the inventory process include, but are not limited to: water suppliers, elected officials, local government agencies (health, planning, natural resources, etc.), local well drillers, local businesses, land developers, community service organizations, public interest groups, farmers, and interested citizens. The team should include long-time residents who can provide an historical perspective, recalling past land uses and locations of abandoned above-ground or underground structures that may pose a threat to groundwater sources. Youth groups and high school clubs are good sources of volunteers, and their participation will help educate them to the importance of wellhead protection. Senior citizens groups have been very helpful in wellhead protection inventories in other states. Community service organizations may also provide volunteer sources. Team members with particular vocational expertise can be helpful. Fire department members have special training in hazardous material management, while medical personnel have experience with biohazardous materials. Hydrogeologists, engineers, and land planners can provide specialized training and experience and can function as educators for the team. Whatever its composition, the source inventory team should include representatives of all sections of the community who have a stake in groundwater protection.

Perhaps the most important task in assembling the source inventory team is the selection of a leader who can keep the team organized and on track. A local official or community leader who has already gained community support may be a good choice for this position. Possible candidates for this position are the mayor, city manager, water superintendent, or a local business person.

Assemble Sources of Information

After developing a source inventory team, but before actually inventorying what contaminant sources are in the area, it is essential to develop a method to manage the information that will be collected. Accurate locations of potential contaminant sources are needed to integrate with the location of the wellhead protection area. A good base map is essential for this purpose. A number of resources exist that will be helpful in developing a base map. City and county plat and zoning maps are readily available. Many Iowa counties have created digital maps or are in the process of doing so. These computer generated maps are generally at a scale of one inch to 100 feet (1:1200) for urban areas and one inch to 400 feet (1:4800) for rural areas. The source for these digital maps are often aerial photographs which can also be very helpful for the inventory. Topographic maps are produced by the United States Geological Survey and are available for purchase from the IDNR-GSB or the Denver office of the USGS. These maps provide useful information, but the scale (1:24,000) might be too small to serve as the primary base map. The base map should show the location of the delineated wellhead protection area.

Before the actual inventory is conducted, all available information pertaining to known contaminants within the wellhead protection area should be collected. Local, county, state, and federal offices often have information concerning facility operations which could provide data on historical, current, or potential contaminant sources. These data can be found in documents such as construction permits, real estate title searches, telephone directories, aerial photographs, discharge permit records, environmental spill files, environmental impact studies, city or county assessors files, zoning records, business licenses, maps and plats, disposal permits, emergency plans, and other historical records. IDNR has files on abandoned and uncontrolled sites, underground storage tanks, solid waste facilities, county solid waste, hazardous substance spills, hazardous materials, RCRA, State-identified sinkholes, the EPA RCRIS and CERCLIS databases. The majority of these records are readily available and can help describe and locate possible contaminant sources. Data on farm histories might be available from the Natural Resources Conservation Service or the Farm Service Agency. NRCS office information not specifically related to a producer is available. Individual case file information can be obtained through the Freedom of Information Act. Individual producers can authorize release of their case file to others. The sanitary survey for a PWS facility may help in identification of potential problems. A list of contaminant source databases and the responsible agency for each is included as Appendix E.

Another valuable source of information concerning potential contaminant sources is the Emergency Planning and Community Right to Know Act of 1986 which was passed as Title III of the Superfund Amendments and Reauthorization Act (SARA). SARA Title III requires communities to identify facilities that store substances on EPA's Extremely Hazardous Substances List or on the Hazardous Material List as defined by the Occupational Safety and Health Administration. This act also requires communities to develop a plan and procedures for responding to releases from those facilities. This will not produce a comprehensive list of facilities storing materials that may impact groundwater, but it will be useful when compiling the contaminant source inventory.

All locations of potential contaminant sources discovered during the previous step should be entered onto the base map before the inventory process begins. The base map will be the major source of information for known potential contaminants that the inventory team will have available to them during the inventory process.

Before initiating an inventory of contaminant sources, each community needs to be familiar with the types of facilities and land uses that may produce groundwater contaminants. Table 8 lists potential sources of groundwater contamination and defines the categories based on the type of operation that may produce contaminants.

The identification of potential pathways that the contaminants can take to enter the groundwater is as important as the identification of all potential contaminants. Certain land uses and structures can act as conduits to accelerate contaminant entrance into the groundwater. It is important that these pathways be identified, particularly for confined aquifers, as these pathways might be the only way for contaminants to reach the groundwater. Wells, either active or abandoned, borings, stormwater drainage pipes, and even floor drains can all facilitate the transport of contaminants. Of particular concern are improperly abandoned wells or improperly grouted wells because they can provide direct access to aquifers. During the field inventory, any structure that might act as a pathway for contaminants should be identified. This information is essential in developing proper management strategies for the wellhead protection area.

Contaminant Source Field Inventory

Once the inventory team is assembled and all available data are obtained and entered onto base maps, the contaminant source inventory can begin. This is an essential step in the wellhead protection process. Having accurate land use information and location data are essential components of the wellhead protection plan. This information is obtained through a thorough contaminant source inventory. The purpose of the inventory is to identify high-risk land uses and activities within the wellhead protection area, confirm the location and type of potential contaminant sources which had been previously identified on the base map, identify additional potential contaminant sources, and identify all potential pathways for contaminants to enter the aquifer. The inventory team should have available the base map and copies of the field inventory form (Table 9).

The inventory process may be accomplished in two steps. First a field survey inventories what land uses exist and identifies site locations. Second an interview process is done to verify what actual contaminants are present at each site identified during the field survey.

Portions of the wellhead protection area that are located in sparsely populated areas might be easy

Table 8. Potential contaminant sources.

Agricultural
Agricultural drainage wells
Animal burial areas
Animal feedlots
Animal research facilities
Chemical application (e.g., pesticides fungicides, and fertilizers)
Chemical storage areas
Grain storage
Irrigation
Manure spreading and pits
Tank loading and rinsing areas

Commercial
Agricultural chemical dealers
Airports
Auto: repair, machinery, service shops
Boat yards / marinas
Car washes
Cemeteries / funeral services
Construction areas
Dry cleaning establishments
Educational institutions (e.g., labs, lawns, and chemical storage areas)
Fuel pipelines
Gas stations
Golf courses (chemical applications and storage)
Grain storage (fumigation)
Degreasng operations
Hardware stores
Jewelry and metal plating
Junk yards
Laundromats
Lumber yards
Material transport (trucks and railroads)
Medical facilities
Paint shops
Photography establishments
Printing / copy shops
Railroad tracks and maintenance yards
Stormwater drains and retention basins
Road deicing operations (road salt)
Road maintenance depots
Storage tanks and pipes (above and below ground)

Industrial
Asphalt plants
Chemical manufacturing, warehousing, and distribution activities
Construction activities
Degreasing operations
Electrical and electronic products and manufacturing
Electroplating and metal fabrication
Foundries
Former manufactured gas plants
Lagoons, pits, holding ponds
Machine and metalworking shops
Manufacturing and distribution sites for cleaning supplies
Mining (surface and underground), mine drainage, and waste piles
Petroleum products production, storage and distribution centers
Pipelines (e.g. oil, gas, coal, and slurry)
Radioactive materials production, distribution, and storage
Storage tanks (above and below ground)
Toxic and hazardous spills
Wells, operating and abandoned (e.g., oil, gas, water supply, injection, Monitoring, and exploration)
Wood preserving facilities

Residential
Cesspools
Fuel storage sites
Furniture and wood strippers and refinishers
Hazardous products (cleaners, paint, oil)
Lawns (chemical application)
Septic systems
Sewer lines
Stormwater drains and retention basins
Swimming pools (e.g., chlorine)
Water softeners

Waste Management
Fire training facilities
Hazardous waste management units (e.g., landfills, land treatment areas, surface impoundments, waste piles incinerators, treatment tanks)
Leaky sewers
Municipal incinerators
Municipal landfills
Municipal wastewater and sewer lines
Open burning sites
Recycling and waste-reduction facilities

Modified from US-EPA 1989, Wellhead Protection Programs: Tools for Local Governments. EPA 440/6-89-002.

Table 9. Wellhead protection potential contaminant site: field survey form.

Date: ______________ Time: ______________

Map site identification number: ______________________ County: ______________
(Be sure to mark base map.)

Name of person conducting survey: ______________

Business or occupant's name: ______________________ Phone: ______________

Owner's name: ______________________ Phone: ______________

Site address or location: ______________________ ______________

City: ______________________ State: ________ Zipcode: ________

Location: ____
(e.g., west side of Main St., north of alley, west side of fire station)

Legal description:
______1/4, of the ______1/4, of the ______1/4, of the ______1/4, of Section ______,

(e.g., NE, NW, SW, SE, Sec. 36, T80N, R5W) Township ______ N, Range ______ W or E

Description: (e.g., two above-ground fuel tanks; barrel of hydraulic fluid; small shed next to building containing (probably) motor oil, paint, grease, and solvents.)

____

____

Conditions: ____
(e.g., *weather:* snow cover, dense fog, saturated ground, driving rainstorm; *access:* fenced, restricted, guard dogs)

Sketch map of site on back (note significant landmarks - include a North arrow)

Use a pen or dark pencil.

to inventory, as there may be only a few potential contaminant sources. Conversely, areas in densely populated or industrial areas might have many potential sources of contamination. Regardless of which case is encountered, the inventory team needs to cover the entire wellhead protection area during the contaminant source inventory process.

Volunteer members of the contaminant source inventory team can conduct the field survey. The members of the team, as discussed above, all bring different expertise to this inventory process. Some strategy, therefore, should be used in assigning inventory areas to certain team members. For example, persons with historical information about certain sections of a community might be assigned to those areas. Members of the business community might be better utilized in areas zoned for business purposes. Persons in the agricultural sector might be better at identifying risks in that setting than would other people. The survey should be designed to take advantage of the diverse background of the team and to maximize the available resources.

The goal of the initial field survey is not to get all of the details about potential contaminants, but it should provide enough information to make informed decisions about which sites need to be revisited and assessed to gather more specific detail. The field survey form (Table 9) asks for the following information:

1. A unique site identification number as assigned by field survey team.
2. Site location (identified on base map with either legal description or address on form).
3. Owner/occupant name, address, phone.
4. Description of the site including a sketch map.
5. Any unusual conditions that can be easily observed (e.g., leaking barrels, bare soil, oil spills, etc.).

A separate field survey form should be filled out for each site that is identified as a potential contaminant source or pathway or is a known or suspected historical site. Not all the information asked for will be immediately known, but the form should be filled out as completely as possible with what information is available. These forms will be used to prioritize the sites for the interview phase of the inventory. Properly completed forms make the prioritization process more accurate and efficient.

Table 10. Land-use risk.

Least Risk ▲ … ▼ Greatest Risk	Risk Score	Land Use Type
	1	Land surrounding a well or reservoir owned by a water company
	1	Permanent open space dedicated to recreation
	1	Federal, state, municipal, or private parks
	1	Woodlands managed for forest products
	2	Field crops: pasture, hay, grains, vegetables
	2	Low-density residential: lots larger than 2 acres
	2	Churches, municipal offices
	3	Agricultural production: dairy, livestock, poultry, nurseries, orchards, berries
	3	Golf courses, quarries
	3	Medium-density residential: lots from 1/2 - 1 acre
	4	Institutional uses: schools, hospitals, nursing homes, prisons, garages, salt storage, sewage treatment facilities
	4	High-density housing: lots smaller than 1/2 acre
	4	Commercial uses: limited hazardous material storage, only sewage disposal, confined animal feeding operations
	5	Improperly abandoned wells in the same aquifer as the supply well
	5	Retail commercial: gasoline, farm equipment, automotive, sales and services, dry cleaners, photo processor, medical arts, furniture strippers, machine shops, radiator repair, printers, fuel oil distributors
	5	Industrial: all forms of manufacturing and processing, research facilities
	5	Underground storage of chemicals, petroleum
	5	Waste disposal: pits, ponds, lagoons; injection wells used for waste disposal; landfills; hazardous waste treatment, storage, and disposal sites; agricultural drainage wells

Prioritization

When the field survey process is complete, a priority ranking system can be developed to identify those sources that pose the greatest risk to groundwater resources. The rank that a site receives should be based on a combination of several factors, including the potential risk associated with the land use, the proximity of the site to the well location, and the vulnerability of the well and the aquifer. There are other factors which will influence the risk associated with any activity. Certain practices may be in place which minimize the likelihood of contaminants migrating from a site. These may not be known at this stage of the inventory process. The prioritization at this stage should be designed as a lead-in to the second inventory stage, at which time more detailed information can be obtained.

Worksheets are provided that can assist you in the prioritization process. Factors that need to be determined are well vulnerability, aquifer vulnerability, and land-use threat vulnerability. Tables 10 through 12 are used to determine scores for these factors. Much of the information needed for

Table 11. Well vulnerability worksheet.

	Yes	No	Don't Know
1) Has your well ever yielded water with nitrate concentrations higher than 5 mg/l as N (half the MCL)?	☐	☐	
2) Does your well have a history of water quality detects for man-made chemicals or contaminants (excluding trihalomethanes (THMs))?	☐	☐	
3) Does raw water from the well have a history of fecal coliform bacteria?	☐	☐	
4) Does surface drainage flow toward the well, or has it been determined by IDNR to be groundwater under the influence of surface water?	☐	☐	
5) Is the well casing leaking?	☐	☐	☐
6) Is the well ungrouted or is the grout seal in poor condition?	☐	☐	☐

Choose only one of the following:

If ***any*** "Yes" box was marked, mark this box: ☐ 2

If ***all*** "No" boxes were marked, mark this box: ☐ 0

If "No" was marked for questions 1, 2, 3 ***and*** 4
and a "Don't Know" was marked for question 5 ***or 6***, mark this box: ☐ 1

Insert the number to the right of the marked box into Table 13 in the column for well vulnerability.

Table 12. Aquifer vulnerability worksheet.

If a public water supply uses more than one aquifer (per well or by multiple wells), use one Aquifer vulnerability worksheet for each aquifer.

Aquifer name:____
(Hydrogeologic name: refer to Table 5)

What is the thickness of the confining materials, such as glacial till or shale, above the aquifer in the WHPA?

<25'	☐	4
25'- 50'	☐	3
51'-100'	☐	2
>100'	☐	1

Insert the number to the right of the marked box into Table 13 in the column for aquifer vulnerability.

these forms will have been gathered during the delineation phase. Scores can then be entered into Table 13 for a calculated score determination for each well. The information gathered during the delineation of the wellhead protection area, such as data on the wells and the aquifer, are needed for this step. A score should be calculated for each contaminant-source site identified during the field inventory. Multiple scores should be calculated for contaminant-source sites that are near more than one well and/or are located in wellhead protection areas with more than one aquifer type. Table 14 is used to determine the collective score for each potential contaminant source site.

Table 10 shows categorized land-use risk scores. The land use identified for each site in the field survey should be located in this table, and then the associated score (1-5) entered in the land-use risk column in Table 13.

Table 11 is a worksheet that can be used to assess well vulnerability. It is designed to make the well assessment easier by providing 'yes' or 'no' questions pertaining to the well. Once these questions are completed, a score for well vulnerability can be entered into the well vulnerability column of the site prioritization worksheet (Table 13). Similarly, Table 12 will help assess the vulnerability of the aquifer from which your well is supplied. The score for aquifer vulnerability should be entered into the appropriate column of Table 13.

A separate copy of Table 13 should be used for each public water supply well. When the scores from Tables 10, 11, and 12 have been entered into the prioritization worksheet found in Table 13, the score for distance of contaminant-source from the well should be entered in column 4 of Table 13. The final score is the sum of columns 3 through 6 and represents the risk of each contaminant-source site to each individual well.

The final step in the prioritization process is a ranking of the contaminant sources for the entire water supply. If the public water supply has multiple wells, the score for each contaminant source should be entered on Table 14 and then the final score determined for each site.

These tables can help in prioritizing contaminant source risk, but the final determination of vulnerability and priority is left up to the judgement of individual public water supplies.

Interview Inventory

Following the field survey and prioritization processes, the final inventory phase can be completed.

Table 13. Site prioritization worksheet.

Well no. __________

Map site ID (from Table 9) (contaminant source)	**Land-use type**	**Land-use risk** (from Table 10) Score: 1 to 5	**Distance of contaminant source from well within the Wellhead Protection Area** Score: <500' = 4, 500-1500' = 3, 1501-2500' = 2, >2500' = 1	**Well vulnerability** (from Table 11) Score: 0, 1, or 2	**Aquifer vulnerability** (from Table 12) Score: 1 to 4	**Total score** Sum of columns 3-6

Table 14. *Site prioritization summary – ranking of sites.*

Total Score from Table 13 for each well by site
* additional columns as needed for multiple wells

Map site ID	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 8	Well 9	Well 10	Well *	Total for all wells	Rank order

The purpose of this inventory is to verify what contaminants are present, in what quantity, how they are used and handled, and what precautions are being taken to prevent them from entering the groundwater. The interviews should be conducted by Wellhead Protection Team Members who are aware of the overall Wellhead Protection Plan and know what information is needed to accomplish the goals of the plan. For example, a community might choose to have the Water Superintendent, City Manager, or the leader of the source inventory team perform the interview inventory. The inventory worksheet used during the interview process should record more in-depth information than the one used during the field survey. Table 15 contains a worksheet designed for this purpose. Public water supplies may lack the legal authority to obtain information from facilities. If requests for information are refused, the fire marshal's office or the county health department may be able to obtain the necessary information based on public health and safety statutes. A wide base of public support for wellhead protection within a community will hopefully alleviate these potential conflicts. Further information on environmental audits for businesses can be found in Chapter 5 on management of wellhead protection areas.

The worksheets for the sites located during the field survey will contain the site identification and location. The owners and/or operators of each site should be interviewed. It is recommended that an appointment be made for this purpose, as they are likely to be busy and may be unreceptive to a drop-in visit. Information that should be obtained during this visit includes:

- List of potential contaminants on site (do Material Safety Data Sheets exist for these?)
- Quantities of each potential contaminant.
- Exact location of each potential contaminant (to include a sketch of the site layout and location of the contaminants).
- Steps being taken to minimize the hazard posed by the potential contaminants.

When the interviews have been conducted for each site, the inventory process is complete. The interview information will be used to formulate the management strategy for the wellhead protection plan, so the accuracy of the information is of vital importance to ensure that the management plans are properly developed as discussed in Chapter 5.

Updates

It is important that the information gathered during the inventory be updated regularly. The frequency of updates will vary based on rate of development or changes in land use in the wellhead protection area. The longest interval between updates should be no more than ten years. IDNR will notify, in advance, public water supplies of new permitted activities within the wellhead protection area. A method will be established whereby public water supplies can notify the IDNR of new non-permitted activities in the wellhead area.

Table 15. Wellhead protection potential contaminant site: inventory form.

Map site identification number: ______________________________

(Key to sketch map)

Description and location of material:

____

____

Volume or quantity of this material on site:

____

____

Handling methods used for this material:

____

____

Are there mitigation measures in place for this material?

____

____

Are there Material Safety Data Sheets (MSDS) available?

____

Use additional sheets as necessary for each contaminant.

CHAPTER 5

MANAGEMENT OPTIONS FOR WELLHEAD PROTECTION AREAS

Overview

- Since the main objective of a wellhead protection plan is protection of the water supply, one of the primary objectives is to prevent contamination from occurring or to minimize the risk that contamination will occur. Management of the potential contaminant sources is thus a critical component in the wellhead plan.

- Both regulatory and non-regulatory approaches are available. The management techniques employed will need to be tailored to the specific needs and resources of the water supplier. This is dependent on the availability of qualified people to accomplish the management tasks, the level of local support, the legal authority to employ regulatory controls, and the money available to accomplish the management goals. Education of the users of the supply as well as those in the wellhead protection zone is strongly encouraged.

- It is to be stressed that management of a wellhead protection zone is not designed to eliminate existing businesses, rather to ensure that operations within a wellhead protection zone are handling their potential contaminants in the best way possible.

- Assistance from a variety of organizations is available for development of some of the options listed in this chapter. Many of these are listed in the tables in previous chapters.

Introduction

At this point in the wellhead protection process, the vulnerable area surrounding the well has been identified, and the potential contaminants within that area have been inventoried. The main objective of the wellhead protection plan is to prevent those contaminants from reaching the well and the groundwater system. Prevention is always safer, cheaper, and more desirable than remediation. It is, therefore, important to identify all of the management techniques available to accomplish this goal. It is the responsibility of the public water suppliers and their communities to develop and implement a local management plan that will be an integral part of a successful wellhead protection plan.

There are a number of tools that can be used to manage potential sources of contamination. These tools can be divided into regulatory and nonregulatory controls. Regulatory controls make use of ordinances and other enforceable measures, while nonregulatory controls promote voluntary action or non-intrusive measures. Management techniques in these two categories can be used to prevent contamination from existing sources located within the wellhead protection area and can also be used to prevent further potential contaminants from entering the area. The distinction between these two is subtle, but it is important to realize that it is not practical to attempt to eliminate all contaminant sources within the wellhead protection area. The sources that exist within the area are likely to remain there and need to be managed. At the same time it is possible to use management techniques to prevent the accumulation of additional sources. Many programs already exist that provide some level of groundwater protection. These programs range from the traditional regulatory approaches (regulations on discharges, permit requirements, zoning) to non-regulatory (hazardous waste collection, education). Descriptions of some of the applicable programs can be found in Tables 2 to 4 in Appendix D.

Many public water supplies in Iowa are managed by private entities. These supplies may not have the legal authority to implement regulatory controls and will instead need to develop plans that rely on non-regulatory controls. Even for municipal supplies that do have some regulatory authority, the delineated wellhead area can lie outside of the legal authority of the PWS. Cooperation from entities with land use control authority is essential for effective protection of the groundwater resource. Development of a multi-disciplinary team composed of a wide variety of groups and organizations at all levels of government will lead to development of an effective wellhead protection program. If a number of public water supplies exist in an area, a regional plan might be considered in place of individual plans.

The most common management tools are listed in Table 16. It is likely that a combination of regulatory and nonregulatory methods will be required to best manage the wellhead protection area. Nonregulatory methods are generally better received by the public and should be used when practical, but it is likely that regulatory methods will be required in many instances for effective prevention.

The population served by each public water supply is unique and will have differing social and economic circumstances. The management techniques employed will need to be tailored to the specific needs and resources of the water supplier. It is necessary for each wellhead protection team to identify the circumstances and resources available before choosing management tools. Some of the things that need to be considered are the availability of qualified people to accomplish

Table 16. Management tools for wellhead protection.

REGULATORY	NONREGULATORY
Zoning Ordinances	Purchase of Property
Subdivision Ordinances	Conservation Easements
Site Plan Review	Public Education
Design Standards	Waste Reduction
Operating Standards	Best Management Practices
Source Prohibitions	Training and Demonstration
Inspection and Testing	Groundwater Monitoring

Source: U.S. EPA, 1993. Wellhead Protection: A Guide for Small Communities

the management tasks, the level of local support, the legal authority to employ regulatory controls, and the money available to accomplish the management goals. For example, purchasing land within the wellhead protection area may be the most effective measure that can be taken, but lack of finances or lack of support for a local tax increase may make this method untenable.

Management Tools

Regulatory

Zoning Ordinances

Zoning ordinances are restrictions designed to control the land use in an area. Several approaches to zoning are possible: revision of existing zoning regulations or enactment of new zoning, overlay zoning which can target areas where protection is most vital, and/or defining conditional uses within a zone based on a set of requirements. These ordinances can be used to restrict certain high-risk land uses within the wellhead protection area. Zoning divides the wellhead protection area into specific regions for residential, commercial, and industrial use. Zoning can also be used to control lot size in unsewered developments. For example, limiting the number of units allowed in a zone can help control the number of septic systems located within the wellhead protection area. Zoning can control the type of land use, development density, placement of structures on lots, street frontage, and placement of parking areas. For purposes of environmental protection, land use control is the most effective zoning function. Zoning is best used for new wells. Land uses in existence before new zoning ordinances are established are usually permitted to continue as nonconforming or grandfathered uses. Even if zoning regulations are not implemented, the concept can be useful, particularly in geologically complex areas, to better target voluntary pollution prevention efforts in the wellhead area. Examples of model ordinances can be found in Appendix F.

Subdivision Ordinances

Subdivision ordinances are applied to land being divided into two or more parcels for the purpose of sale or development. A major function of subdivision ordinances is to ensure that the growth rate does not exceed the necessary infrastructure (i.e., roads, sewers, schools, and fire protection) by enabling local governments to control the use of undeveloped land. As with zoning, these ordinances can be used to control new development, but are not effective in controlling existing developments. These ordinances usually address water supply, groundwater recharge, septic or sewer systems, and surface drainage requirements.

Site Plan Review

Site plan reviews are regulations requiring developers to submit for approval plans for development occurring within a given area. They can be used to ensure that new developments are consistent with the zoned land use and that plans are in compliance with regulations within the wellhead protection area. Site plan reviews should consider the geology of the site and the susceptibility of the aquifer. This management technique requires that time and technical expertise is available on the local level for detailed plan reviews and follow-ups.

Design Standards

Design standards are regulations that apply to the design and construction of new buildings or structures. Many design standards are currently in place under a variety of state programs. There are regulations that specify distance restrictions between public water supplies and potential sources of new contaminants. There are also a variety of programs that set minimum acceptable standards for various activities. Chemical storage facilities, underground storage tanks, wastewater treatment systems, and septic systems are examples of managed activities. Tables 1 and 2 in Appendix D are overviews of the state regulatory programs in place. Further information on any of these can be obtained from the listed state or federal agency. Site plan reviews may include a review of design standards and can be used to mandate that structural controls be in place (i.e., secondary containment structures, berms, impermeable liners) for facilities thought to pose a threat to the groundwater source. As with plan reviews, some technical expertise is required when using design standards for wellhead protection purposes.

Operating Standards

Operating standards are regulations that apply to current land use activities. These regulations help minimize threats to the wellhead protection area by promoting the safe handling, storage, and use of hazardous materials. There are currently state and federal regulations governing many of these activities, and local governments should become familiar with these regulations prior to developing their own. Help may be provided in this area from the IDNR field offices.

Source Prohibitions

Source prohibitions are regulations that can be used to prohibit the presence or use of certain chemicals or hazardous activities within the wellhead protection area. These regulations might be used to prohibit sites such as junkyards, industrial shops, dry cleaning establishments, fertilizer cooperatives, or landfills. Prohibited contaminants can include such things as solvents, heavy metals, or petroleum products. There are a number of state and federal regulations that apply to some of these sources. Local governments may have statutory home rule power to require more stringent control of some contamination sources within the wellhead protection area than are required by federal and state regulations. This power can be used to establish threshold standards beyond which the impact of an activity is not acceptable. This regulatory method requires verification through monitoring of contaminant sources being put into the environment. It should also be noted that although the local government might have the authority to impose source prohibitions, this course of action is one that might receive considerable local opposition. If source prohibition is used, a phased-in approach might be better received.

Inspection and Testing

Inspections by local, state, or federal governments are required at many permitted facilities. The management plan should include information on what inspections are required for facilities in the wellhead protection area and identify responsible agencies. Part of the management program might include checking to ensure that periodic inspections have occurred or, if necessary, requesting inspections of facilities thought to be out-of-compliance and endangering the water source. Again help in understanding current regulations may be obtained from IDNR field offices.

Nonregulatory

Purchase of Property

The purchase of property or development rights is a tool that provides complete control of land uses in a wellhead protection area. This is often expensive, and communities will need to prioritize the areas within the wellhead protection area that are of the most concern. For instance, if the

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Nonregulatory

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The purchase of property or development rights is a tool that provides complete control of land uses in a wellhead protection area. This is often expensive, and communities will need to prioritize the areas within the wellhead protection area that are of the most concern. For instance, if the land around the well is in a high-risk industrial expansion area, land purchase might be justified. For land subject to less risk, land-use controls may provide sufficient protection. When land-use controls are not politically feasible and the purchase of land is affordable, this method may be preferable.

Public Education

A vital part of wellhead protection area management is public education. The support of local citizens is vital if successful management strategies are to be designed and carried out, and public education is a major mechanism for building that support. Public education can consist of pamphlets, brochures, informational meetings, press releases, demonstration projects, road signs, newsletters, internet sites, videotapes, or posters. The educational material should be designed to present wellhead protection problems and efforts to the public in an easy to understand, concise manner. The focus of public education efforts is to make the public aware of what operations or activities can cause contamination, convince them of the need for groundwater protection, and indicate ways to prevent groundwater contamination. Appendix G lists available tools and suggestions for additional efforts.

Waste Disposal

There are a number of household and farm chemicals that have the potential to impact groundwater if not disposed of properly. These materials include pesticides, gasoline, solvents, paints, paint thinner, waste oil, and fertilizers. Improper disposal may allow these chemicals to leach into the area groundwater through infiltration or through storm sewers, septic systems, or sanitary sewers or landfills. It is in a community's interest to help citizens properly dispose of these materials. This can be accomplished by local governments organizing collection days for hazardous materials, or by establishing a centralized location outside of the wellhead protection area where citizens can bring these materials on specified days. It is then the responsibility of local government to ensure that these hazardous materials are disposed of properly. Hazardous waste pickup should be adequately advertised to increase the likelihood of widespread public participation.

Best Management Practices (BMPs)

In Iowa, best management practices (BMPs) are usually associated with agriculture, but they can be applied to business, industry, and homeowners as well. A BMP is a practice designed to reduce the quantities of pollutants that enter surface or groundwater. Industry can reduce potential contamination by implementing pollution prevention programs. Many of the regulatory requirements for businesses include extensive BMP components. These programs analyze the industrial processes that are being used and suggest ways to reduce the potential for accidental releases and/or the amount of waste generated. This can include source reduction through changes in input materials, equipment upgrades, improvements in storage and management, and employee training to reduce accidental releases. Recycling as much material as feasible also reduces the potential for contamination through waste products by reducing the overall waste stream entering the environment. Wastes can also be treated to reduce their toxicity. Technical assistance is available for these programs through several groups including the Iowa Waste Reduction Center at University of Northern Iowa (UNI) and the Waste Management Assistance Division of IDNR. IWRC can aid in on-site audits of a business, identification of the waste stream, and discussion of operating practices.

Examples of agricultural BMPs include soil testing and realistic yield goals to avoid over-fertilization, crop scouting to assess need for and correct application levels of agricultural pesticides, and improving application techniques which minimize loss of fertilizers and pesticides to groundwater. Manure management plans should include proper handling techniques for animal waste products as well as the utilization of the manure as a resource for crop production. Information on agricultural BMPs is available through a variety of agencies including Iowa State University Extension (ISU), NRCS, IDAL, and the Iowa Farm Bureau. Some helpful guidelines are listed in the references.

Homeowners can reduce the risk to groundwater resources through such means as proper application of lawn chemicals, returning used oil to authorized collection facilities, and participating in hazardous waste pick-up days. Promoting the use of BMPs is a major function of public education as discussed earlier.

Local governments need to examine their own practices to determine potential adverse impacts. Many well fields are in parks where lawn products are routinely applied. These practices need to be reviewed and adjusted to minimize potential contamination. Likewise application of chemicals and de-icing salts along roads in the wellhead area should be carefully considered, and reduced if possible. Incentive programs, many of which are in place, can be offered which encourage the plugging of abandoned wells and conversion from individual to community sewer and water systems.

Training and Demonstration

Training and demonstration programs can be designed for a variety of purposes. They can be used to educate those who will be in charge of wellhead protection programs at the local level. Such seminars have been and will continue to be organized on a statewide basis by the IDNR, AWWA, Iowa Groundwater Association (IGWA), and other organizations. Other programs need to be offered to the local public, business and agribusiness communities. These seminars will help to raise awareness of wellhead protection in the local area as well as provide public support.

Other training programs are designed to educate those who deal first-hand with potential contamination sources or respond to accidents when they occur. These programs include training for pesticide applicators, underground storage tank (UST) inspectors, and emergency response teams.

Demonstration programs can be very effective in promoting BMPs. Agricultural demonstration projects are common in Iowa; similar demonstrations could be set-up for local business, industry, or homeowner/residential groups to illustrate effective pollution prevention programs.

Groundwater Monitoring

Groundwater monitoring consists of regular sampling of the water wells to determine the presence and concentrations of contaminants. Monitoring in a wellhead protection program can serve as an early warning system to identify migration of contaminants toward public wells. Monitoring programs can provide information on whether management programs in place need revision, or if some contaminant clean-up action is needed. In some cases private wells can be integrated into a monitoring program. Knowledge of well characteristics is required for this to be effective. Some facilities may already have monitoring wells in place as part of operating standards. Monitoring programs are expensive, but they can be less expensive than the costs of cleaning a contaminated water supply or loss of commercial and industrial enterprises.

Management Options for Noncommunity Public Water Supplies

Feasible management approaches for noncommunity systems may be very different than described above. Management for these supplies will be closely tied to the results of the IDNR sanitary survey process. Owners and operators of noncommunity public water supplies should direct their attention to control of potential sources of contamination on their own property. In addition, it may be possible to develop coordinated wellhead protection programs within a region that would benefit both community and noncommunity public water supplies.

Summary

Managing potential contaminant sources within the wellhead protection area is the most important aspect of the wellhead protection plan. It is also the most difficult and time-consuming component, and requires adequate forethought and planning. Each community must balance the rights of private property owners within the wellhead protection area with the responsibility of protecting the citizens of the community from the health and financial effects of possible groundwater contamination. Management of the wellhead protection area also involves, and must be tailored around, the personnel and financial resources of the community. Regulatory management tools such as zoning are the most common means of environmental protection, but are not always the most popular or the most feasible. Nonregulatory methods are often more popular because they are less intrusive, but are often more expensive to administer and harder to monitor effectively. Gaining local support through public education must be part of the process of wellhead area management if the program is to succeed.

The threats to groundwater resources within the wellhead protection area are certain to change over time. New sources will enter the area and old sources will be removed. As new water supply wells are added or old wells removed, the size of the wellhead protection area will need to be modified. Because of these factors, the management strategy must be updated as conditions warrant. These updates should be done at short enough intervals to ensure that the public water supply remains adequately protected. Review of the wellhead protection plan will be included as part of the IDNR five-year interval sanitary survey process.

CHAPTER 6

CONTINGENCY PLANNING

Overview

- Despite prevention and planning, unforeseen accidents can occur and cause a disruption in the water supply. A water supply emergency can be short-term or can necessitate the replacement of the water supply. Contingency planning is needed to prepare a response for these potential emergencies.

- A team should be organized who can respond to a water supply emergency at any time. The team leader should have adequate authority for decision making and expenditures of funds. Team members should be trained and kept cognizant of any changes in the plan.

- All information relevant to the water supply such as distribution maps, well details, plant operations should be included in the contingency plan. In addition contact names and phone numbers of response personnel, team members, and others that can provide technical assistance should be included.

- Communication with the users of the system is vital in minimizing public confusion and may lead to prevention of health problems if the source becomes contaminated. Methods of communication should be established in advance (newspapers, radio, etc.).

- Replacement supplies need to be identified in advance. Mutual aid agreements with surrounding communities, industries, contractors and related utilities should be developed in advance of any emergency.

- Updates of the plan should occur regularly. Ongoing updates of contact names and phone numbers is vital. Training of replacement team members will be necessary over time. Periodic meetings or drills could be helpful.

Introduction

The management tools discussed in the previous chapter are designed to help prevent groundwater contamination. Contingency planning is important for all systems because, even with careful planning, unforeseen incidents can occur. Groundwater contamination can result from natural disasters (e.g., fires, floods, tornadoes) or accidental releases (spills, leaks, illegal discharges, accidents) in the wellhead protection area. A contingency plan is designed to help a community react quickly and efficiently to a disruption in its drinking water supply. The contingency plan should be developed by local water suppliers and government officials to outline the emergency procedures to be followed in the event of water service interruption.

The State of Iowa has prepared a general contingency plan for providing drinking water during emergencies. Entitled the Drinking Water Supply Contingency Emergency Plan, it has been in place since 1992. The plan was developed by the Environmental Protection Division of the IDNR and is included as Appendix H. All water suppliers are encouraged to develop a contingency plan applicable to their needs.

The Des Moines Water Works and the Iowa Section of the AWWA have, under contract with IDNR-EPD, prepared a model plan entitled Emergency Preparedness: Preparing for the Unanticipated. This plan and accompanying worksheets provide a useful tool for compiling the needed information for a contingency plan. Copies of the plan can be obtained from IDNR-EPD. There are several other documents available that can assist public water suppliers in preparing a contingency plan. These are listed in the reference section.

Contents of the Contingency Plan

All information relevant to a water supply emergency should be contained in the contingency plan and accessible to response personnel. The structure and language of the plan should be as simple and clear as possible because the primary purpose of the plan is to provide vital information and guidance to the immediate response personnel during or immediately following a water supply disruption or contamination incident.

The plan should be structured to address potential problems with the water supply and it should not be filled with extensive material addressing problems that are unlikely to be encountered by the community. The plan should be as user friendly as possible, increasing the likelihood that it will actually be used during an emergency.

Background Information

The information in this section is vital to implementing a properly prepared contingency plan. Information is needed on water sources and water system characteristics of the public water supply. A clear map of the wellhead protection area including any information on travel time should be included. A brief description of aquifer characteristics should be included along with copies of the well logs prepared earlier in the plan. The information obtained during the contaminant inventory process is a valuable resource for response teams for some types of emergencies. The inventory identifies owners, addresses, telephone numbers, and potential contaminant sources at facilities within the wellhead protection area. A sketch of the distribution system showing where wells, pumps, valves, and storage tanks are located should also be included. Treatment system details should be included. The system requirements for water supply (average daily use, peak capacity, minimum pressure and storage requirements) should be detailed as well as an evaluation of system capacity to meet current and future needs. Specific suggestions for a system vulnerability analysis are in the State plan in Appendix H.

Duties and Responsibilities for Emergency Response

A response team should be formed and consist of persons familiar with the water supply. People are needed to coordinate the response, communicate with other agencies and the public, assess appropriate actions for dealing with the immediate problem, and evaluate necessary actions for restoring the water-supply capability. Sufficient personnel should be included so that an adequate response can be made even if some team members are away. In larger communities, the city water supply staff might compose the members of the response team. In smaller communities with potentially a single water supply operator, members of the response team may be recruited from the community. In both settings it would be advisable to have members of the city and/or county fire and police departments on the committee.

The contingency plan should clearly designate the chain of command and who is responsible for decision making. One role of this person would be to ensure that the lines of communication remain open so that all necessary people are kept up-to-date on events and actions taken.

The roles and responsibilities of other agencies must also be identified when certain types of emergencies occur. Many emergency situations will require immediate action by agencies other than the water department. Many responses to emergencies that may affect the water supply will originate outside of the water supply by emergency response units (fire/police). It is important that communication among the many agencies be maintained. Other response units must be aware of the potential impact of their actions on the water supply.

When emergencies do occur, timely notification of response personnel is very important. A notification roster should provide information that will allow emergency response team members to be contacted 24 hours a day, seven days a week. The roster should contain the names of all emergency responders, their titles, addresses, and all applicable phone numbers. If pagers are employed, the pager information should also be included on the roster. Certain types of emergencies may negate the use of normal channels of communication. Provisions need to be made for an efficient and fail-safe form of communication to be available during emergency conditions when the use of normal facilities may be denied by the crisis.

Responsibilities of the team and the coordinator include the following:

1. Estimate the effect of the particular emergency upon the system.
2. Estimate system capability to deliver potable water.
3. Estimate community requirements for potable water under conditions imposed by the emergency situation and determine the level of service which would be required.
4. Establish priorities for use of available quantities of water.
5. Assign specific work assignments to water system personnel and establish utilization of outside services and/or auxiliary work forces as necessary.
6. Initiate mutual aid agreements with surrounding communities, industries, contractors, and related utilities. These agreements could provide for assistance in the form of personnel, equipment, money, or materials as required.
7. Contact appropriate agencies as required for assistance.
8. Logistical Support Services

One of the key objectives of the contingency plan is to ensure that the proper personnel, equipment, and technical resources are available in case of a water supply disruption. The plan should enable local officials to rapidly identify and coordinate these resources in actual emergency situations. Clearly identifying these items will facilitate the notification and logistical coordination procedures that will govern responses to water supply disruptions.

Resource inventories must reflect only those resources that are currently on hand or readily available in an emergency. The planning process may identify personnel and equipment needs that should be filled at some time in the future. These resources, however, should only be placed in the background information and response procedures sections when they are in fact on hand.

Other government agencies may be able to offer assistance during emergencies. The IDNR has primary enforcement responsibility under the SDWA (Public Law 93-523) and has developed an emergency drinking water supply plan (Appendix H). The primary goal of the IDNR will be to provide technical advice and to help coordinate relief efforts of outside agencies. It is important for local water utilities to know or have ready access to phone numbers of the respective IDNR field offices. The first avenue of approach to the IDNR should be the appropriate field office or in some situations the Emergency Response number (515-281-8694). These IDNR personnel will assume the responsibility of notifying other impacted IDNR staff in Des Moines. Stress should be placed on the necessity of notifying the field office regardless of the relative severity of the emergency situation. Notification by the local utility should be made during normal business hours at the first opportunity following the onset of the emergency.

The U.S. EPA may provide assistance for a contaminated water supply under the CERCLA (Superfund) program. Assistance for a contaminated supply may simply involve providing bottled water if an immediate health threat exists. Such action would be under the "removal" branch of Superfund. Other remedial actions can include short-term measures to eliminate or stabilize hazardous conditions. The "remedial" branch of Superfund addresses long-term cleanup of contamination. The EPA will seek reimbursement of all costs from the parties responsible for the contamination.

The U.S. Army Corps of Engineers (ACOE) is authorized to provide clean drinking water to communities if contaminated water is posing a threat to public health or in drought-distressed areas. Requests for this assistance should be made through the Governor's Office to the appropriate Corps District Office.

The U.S. Federal Emergency Management Agency (FEMA), under the Disaster Relief Act Amendments of 1974, provides various services including relief efforts during emergencies.

The University of Iowa Hygienic Laboratory (UHL) provides laboratory assistance to all public water systems within the state. This service will enable systems to test for water purity beyond their individual capability and identify the nature of their problems in minimal time. The UHL can be contacted in Iowa City at 319-335-4500 or in Des Moines at 515-281-5371.

Mutual aid agreements with surrounding communities, industries, contractors and related utilities should be developed in advance of any emergency. Local businesses such as dairies, well drillers, or railroads may have tank trucks that can be made suitable for carrying water. Other companies may have equipment such as chlorinators or generators for loan. Irrigation supply companies may have pipe that can be used to extend water supply lines on the ground. Other water utilities in the area may have spare parts (valves, pumps, pipe) which may be available for use in an emergency. These groups may also be able to supply personnel to assist during emergencies.

Replacement of Short- and Long-Term Water Supply

The contingency plan must address the question of where a community can obtain water if a disruption in service takes place. Depending on the nature of the problem, an alternative source may be required for hours or days, or permanently.

A priority of contingency planning is the identification of appropriate emergency options, both short-term and long-term, for a replacement water supply. The emergency response team can then decide upon the best alternative, based on the situation.

The EPA defines five categories of alternative water supplies:

- Supply from within the system (standby wells).
- Supply from outside the system (neighboring community or bottled water).
- Modification or reduction of water use (water use restrictions).
- Water supply treatment.
- Aquifer remediation.

When determining alternate water sources, all possibilities should be considered. The sources used should be those that best fit the water system characteristics, and are feasible from cost and logistical standpoints. Under most circumstances aquifer remediation is the most expensive alternative. The cost of aquifer remediation emphasizes how important it is to prevent contamination rather than cleaning it up once it has occurred.

When deciding on alternate water sources these questions should be considered:

- Is the alternative technically and logistically feasible?
- Is the new water source reliable?
- What are the relative costs of the various alternatives?

Having an additional water source available for emergencies within the community reduces dependence on a sole, vulnerable source. The extra water source may be expensive to maintain if it is not needed, but the costs of getting water from outside sources or through aquifer restoration may be much higher than paying for a backup source now, when it is not immediately needed.

Options for replacement of water should consider all available sources of water, not just those utilized under conditions of normal operation. These sources might include both groundwater and surface water, public or private ponds, reservoirs, swimming pools, interconnections with other water utilities, water stored within building water systems (hot water tanks, etc.), water provided in bottles or tank trucks from outside sources of potable water or local dairies or bottling plants. Procedures necessary for temporary treatment and emergency pumping of non-potable water sources with portable equipment also need to be evaluated.

Placing restrictions on water use in emergencies is a valuable tool available to communities that can be accomplished quickly and inexpensively. It is often only a partial solution, because it may not reduce the water use as much as needed. Guidelines for rationing of potable water should be included in the plan. These might include a distribution system utilizing tank trucks dispensing water into containers provided by each consumer at a minimum level of service, isolation of various portions of the distribution system by selective valving, or public orders as to purposes for which water might be used by individual customers. IDNR publishes a document entitled "Water Conservation for Small Utilities, A Practical Guide to Local Water Conservation Planning," which has valuable suggestions as to types of usage which can easily be restricted in emergencies. Emergency conservation plans should be developed

Treatment may be a possible longer term solution to water contamination problems. Such alternatives are somewhat difficult to evaluate in advance depending on the nature of the contamination. Information on the existing treatment system is necessary. Aquifer remediation may also be a part of this consideration.

Long-term, replacement water supplies should be considered. Then, if it becomes necessary to replace a well or a water source, action can begin sooner than if alternatives had not been identified. General information on the availability of sources (other groundwater aquifers, surface water) and potential locations for new wells should be included as part of the plan.

Financial Resources

Any water supply emergency will be expensive to manage and correct. How expensive depends on the severity of the emergency and the resources used. In planning for water supply needs, communities first need to evaluate their financial resources. All funding approaches should be considered, including property tax assessment, specialty taxes, user charges, and short-term and long-term borrowing. Funds that could be available through the normal operating, capital, and emergency budgets should be identified. Communities may need to create new contingency or reserve accounts, bonding authority, or lines of credit for emergency water supply needs. Some Federal and State money may also be available, depending upon the nature of the emergency. Identification of all of these financial sources before an emergency occurs will help communities be more financially prepared for a water supply disruption.

In addition, the authority to expend funds needs to be established in advance. An actual emergency is not the time to resolve institutional conflicts as to lines of authority. The coordinator of the emergency response team is a likely candidate to be given this responsibility.

Public Communication

Effective communication with the public before and after a water supply disruption is important for several reasons. Public notification is a legal requirement for many situations under the SDWA statutes. For example, health considerations may require that a boil-water notice be issued. Effective communication can minimize public confusion and can help secure public cooperation in implementing such response measures as water conservation. Educating the public about the wellhead protection program, the water system, and contingency planning will help foster understanding of the issues involved during a water supply emergency.

Public notification in connection with a given emergency should present the following information:

1. The nature and expected duration of the emergency.
2. The geographical extent of the area affected.
3. Limits on consumption of water if necessary.
4. Possible disinfection procedures required for drinking water in the case of system contamination.

5. Locations for alternate supplies of potable water.
6. Inform public as to necessity of providing containers if needed.
7. Sources for more detailed information.
8. Information as to the process of recovery, progress reports, and amended recovery schedules.

Pre-emergency information regarding the ability of the utility to combat a crisis situation is an important public relations tool. Professional help is an asset in the production of this material. The AWWA has information available for purchase in bulk lots that may prove useful.

Emergency notification of the public and affected businesses needs to be accomplished rapidly and must involve all possible media to be sure of the widest possible distribution. Local radio and television stations should be given first consideration because of the rapidity with which news can be disseminated by these media. Local newspapers should receive news releases at the same time they are provided to the radio and TV facilities; however, actual time of publication of the items will depend on the paper's deadline. Notices posted on bulletin boards and the use of sound trucks may provide information quickly to those persons not immediately exposed to the other media. Recordings describing much of the available up-to-date information may be used in connection with the water system's normal telephone service.

Typical news releases, especially those giving initial notice of "boil water" or water conservation orders should be prepared in advance to insure their early publication when the emergency strikes. The list of persons pre-authorized to prepare and release such news items should be layered to insure that at least one person will always be available and have the authority to cause prompt publication. The proper preparation of these news releases may require the cooperative efforts of governmental staff (mayor, city manager), water system personnel (manager, service director, engineer), together with representatives from the local health authority. Assistance may also be available from local media persons. Having typical press releases ready when the emergency strikes may save hours of time and could prevent serious health problems within the community. In summary, thorough communication will assure a smoother path to recovery and enhanced customer relations, whatever the nature of the emergency.

Relationship to Other Emergency Response Plans

It is important to identify how the wellhead protection contingency plan fits into the framework of a community's present emergency response plan. The plan should be structured so that the response to an emergency situation is effective. It is important that emergency plans be carried out smoothly, and that delay, confusion, and duplication of effort are avoided. The contingency plan should be coordinated with local and county emergency plans, so the committees in charge of these existing plans are included in the contingency plan process whenever possible.

Prevention and Training

While developing the plan, communities may find areas that need to be addressed which can mitigate possible disruptions of water service. For example, during the background check, a community might discover a method for minimizing the effect of a well shut down, which could lead to temporary water use restrictions rather than an alternate water source. Other items to look for might include shortage of equipment, inadequate personnel training, and lack of mutual aid response agreements with neighboring communities. The contingency plan should set a time frame for all of these issues to be addressed.

Training local emergency response personnel in emergency response procedures helps ensure that response will be smoother and more efficient in the event of a real emergency. Training is an ongoing requirement and may take several forms such as review of the contingency plan, identifying the various hazardous materials in the wellhead protection area, learning how to contain and mitigate a spill, and response to mock emergencies. The Iowa Emergency Management Division has considerable experience with emergency response and can set up practice disaster exercises for communities. New personnel will need complete training, while veterans may require only periodic refresher training. It may be helpful to have occasional drills to simulate a real emergency.

Reviewing and Updating the Contingency Plan

The contingency plan details emergency response procedures necessary to respond to a water supply emergency. The proper procedures to follow are likely to change as circumstances change and communities grow. Keeping the contingency plan current is essential for using it successfully in an emergency. Personnel, material and equipment suppliers, repair facilities, contractors, and government agencies are all prone to daily changes in contact persons, addresses and phone numbers. The plan must be corrected to complement system modifications that take place after the plan's initial preparation. Incorporating a method to update the plan periodically helps ensure that it will be kept current as circumstances change in the community and in the wellhead protection area. The contingency plan should be a dynamic document that will help officials provide efficient and effective response to water-supply emergencies regardless of when they occur.

IDNR advises taking a look at the contingency plan at least once every three years. The Iowa DNR may assist local public water supplies by reviewing local emergency plans in order to judge the general adequacy of those plans. A checklist for appraisal of contingency plans is included in the state plan in Appendix H. Current local emergency plans are to be available for evaluation at the time of the water supply sanitary survey by Iowa DNR Regional Office personnel. Such a review keeps local emergency plans up to date and reinforces the plan contents and procedures in the minds of those who will implement them.

CHAPTER 7

NEW WELLS

Overview

- It is recommended that a wellhead protection area delineation be supplied when applying for a new public well permit for a community system.

- A wellhead area delineation and initial contaminant inventory will be done by the IDNR-GSB once the well has been installed.

- It is recommended that public water supplies develop wellhead protection plans for new wells.

Implementation

A key component of the wellhead protection process is the procedure for siting new wells. Protecting an existing well can be problematic, as its location may have been chosen based on factors other than proximity to contaminant sources. Protecting new wells can be somewhat easier because wellhead protection procedures can help determine where the well should be located. Wellhead protection is likely to be more effective for new wells for a number of reasons:

1. Potential well sites can be evaluated for existing contaminant sources and a site can be selected that is least likely to be affected by those sources.
2. Local zoning can be enacted prior to well installation to ensure that high-risk land uses do not occur within the wellhead protection area.
3. The number of land owners affected by the wellhead protection area can be minimized by careful site selection, thereby reducing opposition to the plan.
4. Management resources can be more efficiently used with careful site selection.
5. Constructing new wells according to state well construction codes reduces their vulnerability to contamination, thereby enhancing the effectiveness of the wellhead protection plan.

For each potential new well site, public water suppliers are encouraged to determine a wellhead protection area based on existing hydrogeological information and design specifications for the well. At a minimum, a fixed-radius approach should be used to define these conceptual wellhead